ANNUAL REPORT

OF THE

COMMISSIONER OF AGRICULTURE

FOR

THE YEAR 1878.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1879.

IN THE SENATE OF THE UNITED STATES,
March 3, 1879.

The following resolution was agreed to by the Senate February 27, 1879, and concurred in by the House of Representatives March 3, 1879:

Resolved by the Senate (the House of Representatives concurring), That there be printed three hundred thousand copies of the Report of the Commissioner of Agriculture for 1878; two hundred and twenty-four thousand copies for the use of the House of Representatives, fifty-six thousand copies for the use of the Senate, and twenty thousand copies for the use of the Department of Agriculture.

Attest:

GEO. C. GORHAM,
Secretary.

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REPORT

OF THE

COMMISSIONER OF AGRICULTURE.

DEPARTMENT OF AGRICULTURE,
Washington, D. C., November 15, 1878.

To the President:

SIR: Again for the fourth consecutive year the earth has rewarded the toil of our husbandmen by a bountiful yield of nearly all of the diversified objects of our agriculture, and we have abundant reason for grateful acknowledgment to the bounteous Giver of all good things. A contrast of the condition of our people with a portion of the inhabitants of the great Chinese Empire, where hundreds of thousands have perished miserably because of the failure, in certain sections, of the rice crop, on which alone they depended for subsistence, enforces most emphatically the wisdom of insisting upon a diversity of agricultural products. The Department of Agriculture has for one of its leading objects the introduction of all the productions of the earth that can be grown in any part of our country, and to encourage by every means that diversity of production which is at once the safety and the wealth of the nation.

In the endeavor to faithfully execute my duties as Commissioner of Agriculture my efforts have been ably seconded by the heads of divisions, clerks, and employés of the department during the past year. The work intrusted to them all has been faithfully and diligently performed, and I hope will result in valuable and permanent benefit to the whole country.

The work of the *Chemical Division* of the Department of Agriculture during the year may be summarized as follows:

1. Examination of minerals, including calcareous and phosphate marls, rock phosphate, &c., (81 in number).
2. Analyses of mineral, spring, and well water (10 in number).
3. Analyses of soils (4 in number).
4. Analyses of sugar-beets (45 specimens).
5. Analyses of cane, maize, and sorghum sugars (8 samples).
6. Analysis of beet sirup.
7. Analysis of sorghum sirup.
8. Analysis of brewers' grain, to ascertain the food value thereof.
9. Analyses of fertilizers, superphosphates, &c. (4 samples).
10. Examination of plants for narcotic poisons or other alkaloids (5 specimens).

11. Examination of deposit in spring water.

12. Examination of peat, to determine its value as a fertilizer, and as a source of paraffine or oils.

13. Examination of cream puffs, for mineral or vegetable poisons, for the Board of Health of District of Columbia.

14. Examination of adulterated tea, for Board of Health of District of Columbia.

15. Examination of Bologna sausage, for mineral and organic poisons, for the Board of Health of District of Columbia.

16. Examination of the "Nuisance," for the Health Officer of District of Columbia.

17. Examination of postal cards, for the Post-Office Department.

18. Examination of canceled postage-stamps.

19. Analyses of two samples of oleomargarine, for committee of House of Representatives.

20. Analyses for the Treasury Department, including:

a. Fourteen samples of Demerara sugar.

b. A sample of iron rust.

c. Bottle of suspected compound.

21. Examination of whisky for fusil oils.

22. Examination of seed-pods of the algarobo.

23. Examination of tannin in canaigre.

24. Examination of Youpon for theine.

25. Examination of oil from tea seed.

26. Examination of so-called bombic acid.

27. Analysis of covering of the eggs of insects.

28. Analysis of ash of sorghum.

29. Analysis of three samples of earth from niter caves.

30. Analysis of three samples of lime.

31. Analysis of baking-powders.

32. Examination of siliceous diatoms.

33. Analysis of shell of egg from hen dying of cholera.

34. Analysis of yam.

35. Analyses of proximate constituents and of the ash of native grasses, including—

a. Fifteen from Alabama.

b. Twelve from Texas.

c. Four from Georgia.

d. Three from Wisconsin.

e. Two from Illinois.

f. Two from Mississippi.

g. One from South Carolina.

36. Experiments in preparation of tea from leaves obtained from—

a. Department grounds.

b. North Carolina (4 lots).

c. South Carolina (4 lots).

d. Georgia (2 lots).

37. Experiments in the manufacture of sugar from—

a. Sorghum.

b. Maize.

c. Millet.

d. Teosinte or Euchlæna luxurians.

Among the minerals that have been analyzed are specimens from nearly every section of the country, many of them giving evidence of the existence of valuable mineral deposits, which warrant a more thorough examination. It has been the desire of this department to assist, as far as could be done without interference with our regular work, in the development of these mineral resources of the country.

The examination of two new materials, the algarobo and the canaigre, for tannin, shows the existence of a very abundant source of this important material, and gives reason for the belief that the latter at least may soon afford a cheap supply to the arts. Thus far only a preliminary examination has been made, but the investigation is being continued, and will, it is hoped, have reached definite conclusions before the publication of the annual Report, of which this will be a part. The importance of a new and cheap source from which tannin may be readily obtained can scarcely be overestimated, and the most diligent prosecution of this search in various directions will be continued until success is assured. The amount of barks and other substances, valued for their tannin, reaches many millions of dollars yearly, and, if the canaigre root answers our expectations, the world's supply may be easily grown by our own people.

Among the interesting subjects of investigation and progress which have been undertaken by this department, and which are yet incomplete, is the increase of our production of sugar. Failing (as yet) in obtaining a new variety of seed-cane from Tampico, which I had contracted for in some considerable quantity, I was gratified to receive from our correspondent in Japan a small lot of the best varieties grown there, and also, through the efforts of Dr. T. G. Richardson, of the State University of Louisiana, a small quantity from the Sandwich Islands, to whom, likewise, I am indebted for some 22 varieties of seed-cane, as well as for other plants and seeds from Brazil.

It is too early as yet to predict the results of these various trials, but a variety of cane from Jamaica, called the "Salangore," is apparently worthy of extensive introduction and trial; and, accordingly, action has been taken to secure a moderate amount for this purpose. Without remitting in any degree efforts to increase sugar production by encouraging the cultivation of the tropical cane (with that end advising the divorce of the mechanical from the agricultural part of the business, and the establishment of the central factory system), and also by obtaining and distributing the best sugar-beet seed to be had, and collecting such facts on the production of sugar from beets as would give a fair state-

ment of the present and prospective condition of these industries, my attention has of late been more especially given to the question of producing large supplies of sugar from sorghum and maize, and one or two other sugar-yielding plants.

Satisfied of the extraordinary qualities of a variety of sorghum called the "Minnesota Early Amber," I procured as much of the pure, well-cured seed as possible, and distributed the same in every Congressional district in the United States. The results of this distribution have been uniformly favorable, and the variety is recognized as a great acquisition, yielding everywhere a large amount of rich saccharine juice, which, under proper treatment, gives a first-class article of cane sugar and sirup, the yield being from 120 to 250 gallons of heavy sirup to the acre. Mr. Seth Kenny, of Morristown, Rice County, Minnesota, who first made sugar from "Early Amber" cane, writes that he has made this season, for himself and neighbors, 4,240 gallons of sirup, of which, at the time of writing, he had sold 720 gallons at 7 cents per gallon, and 13 barrels of which were grained into mush sugar. A large amount of sugar and sirup was made in other parts of Minnesota during the past season from this "Early Amber" cane, and much excellent sirup, with some sugar, in many other parts of the country.

Many of those who have planted this sorghum the past year announce their intention of cultivating an increased area another season, which goes to show that the crop has not been unprofitable.

There being no vacant space in the grounds attached to the Department of Agriculture suitable for the purpose of conducting experiments in this direction, I was compelled to seek the aid of farmers in the vicinity of the city, and it was with some difficulty that any one could be found in the neighborhood of Washington who would consent to plant seed of the "Early Amber" cane, a crop of which was desired for experiments here. Small patches were finally planted on three farms, but these were allowed to grow without thinning, and of course the product was in no sort a typical one, the cane used in our experiments (details of which are given elsewhere) being only large-sized grass, not exceeding the girth of a man's thumb, rather than the full-sized stalk to which it would have attained under moderately favorable cultivation; and yet, despite this and other untoward circumstances attending our experiment, it has sufficed to demonstrate the fact—if, indeed, other demonstration than the practical results as to sorghum in Minnesota and elsewhere, and maize in Pennsylvania, were needed—that there exists in these two plants a large amount of sugar, which may be readily obtained, and that the aggregate amount possible from this source would be practically unlimited. Indeed, were but one or two per cent. of our present corn crop given over to the production of sugar it would readily yield an amount equal to the entire annual importation of this important product.

The experiments thus far made have scarcely been sufficient to accu-

rately determine the actual cost of the production of sugar from these sources, but they have sufficed to settle the question of its production with no further care than is required in making good butter and cheese.

It is the determination of the department that these important experiments shall be prosecuted to the end, and it is believed that the work of another season will suffice to place this whole matter upon a sound practical basis. To this end, it would appear desirable that experiments be made upon a generous scale in the matter of different varieties of maize and sorghum, different modes of cultivation, the stage of growth at which the production of sugar is at its maximum, in order that with no further delay than is necessary the country may be prepared with all necessary data to enter intelligently upon this new industry, which promises to be one of the greatest of the near future.

In addition to the experiments made with maize and sorghum, other allied grasses were subjected to the same treatment. A few seeds of pearl millet, which had been sown late in the season to test its value as a forage plant, produced a large growth of blades and stalks. The presence of saccharine matter in considerable quantity was so apparent that the stalks were stripped and put through the mill, and the juice gave a fair quantity of readily crystallizable sugar of good quality.

Whether this new sugar plant is worthy the attention of the farmer will be definitely ascertained during the coming season, by early planting, and by thinning the rows to secure larger growth of the stalks and a greater amount of juice.

An experiment with teasinte, a small quantity of the seed of which had been procured from Vilmorin & Co., of Paris, was made after frost had cut the leaves of the plant and injured the stalks, and although a fair proportion of sirup was obtained, crystallization could not be induced, and the results were unsatisfactory.

While a detailed account of these various experiments belongs properly to the body of our annual, mention of them is included in this prefatory report in order that some of the facts known may the sooner be laid before those interested, and that they may thus be induced to make such preparation during the coming spring and summer for the cultivation and manufacture of sugar as may to them seem desirable.

The very great interest manifested in this matter is evinced by daily inquiries from all parts of the United States, and when it is known that sugar and sirup of excellent quality can be cheaply made from the juice of sorghum and maize, with the exercise of as little skill and care as is required in many other farming operations, and with an insignificant outlay for machinery and chemicals, thousands in place of hundreds will engage in producing them, the more especially when it is seen that they are articles as merchantable as wheat in the markets of the world.

Thus a new industry will stimulate into renewed activity not only the agriculture, but the manufactures and commerce of the country, wherever maize or sorghum can be grown, and one or both are already familiar plants in nearly every county in the United States.

In the effort to introduce the cultivation of the tea plant and the manufacture of tea, reasonable progress has been made. In Assam, India, the native home of the tea plant, the English Government, recognizing the great importance of the subject, years since undertook the establishment of tea culture, and after many failures and at great expense has at last succeeded in making it a permanent and profitable industry.

Here, with a climate and soil admirably adapted to the growth of the plant, and a people whose mechanical ingenuity is always equal to any emergency, there can be no doubt whatever of the ultimate success of this industry, but it must necessarily be of slow growth.

Under the most favorable circumstances, and with the best cultivation, the trees will yield but few pickings the third year after planting, and not until the fifth year may we look for enough leaves from the fifty thousand tea plants, sent out by the department this year, to commence in earnest the manufacture of tea for commercial purposes. During all this time it will be the duty of this department to watch over and encourage the industry, to give a thorough chemical analysis of the tea leaves at various periods of growth, and to suggest or invent simple methods of preparation.

From leaves raised in the department grounds and obtained from the Carolinas and Georgia, experiments have been made in the laboratory after the methods of the Japanese as reported by importers and other authorities, and with such success in some of the samples as to obtain the warm commendation of experts and dealers, who declared the tea made to be "excellent Oolong—as good as could be bought anywhere."

It is well known that nature is capricious in regard to the production of flavors, and the place or places in which the highest-flavored and finest teas can be produced will only be discovered by trial, and it is the duty of this department to see that the trial is thoroughly made, whether success or failure be the result.

The question whether our people can compete with the acquired dexterity and cheap labor of Asia will be answered, when the time comes, by mechanical inventions that will do the work cheaper and better.

Meanwhile nearly every family in the Middle and Southern States may grow their own tea, and better tea than they at present buy in the general markets, if they do nothing more.

The analysis of our native grasses has been extended to thirty-nine species, and has already resulted in the conclusion that there exist very many uncultivated grasses which may fairly claim equal merit with many of our standard varieties. It is proposed to give in the Annual Report, to which this will be introductory, full analyses of the proximate constituents of these grasses and of their several ashes, and a botanical description of each, with a full account of their natural history, including distribution, habit of growth, and other information, which will enable our farmers to select such as shall promise to be desirable additions to their forage plants.

The high importance of this investigation cannot fail to be appreciated by every farmer having cattle to feed or pasture. The Hon. T. C. Jones, of Delaware, Ohio, whose judicial fame is not more widely recognized than his successful practice in the most advanced agriculture, declared in a conversation upon this subject, that nothing was more needed at the present, or would be of more value to this country, than a thorough analyses of the different grasses now in common use at various points of their growth, and this opinion will be confirmed by every intelligent farmer who will give the subject thoughtful attention. An investigation of this character will therefore be entered upon and prosecuted so far as the limited means of the department will permit. It is the more important, because of unmistakable indications that the grass lands (upon which the agricultural prosperity of the people, in many of the States, wholly depends), are becoming, year by year, less productive. It remains to be seen whether by the introduction of new varieties and a system of rotation this exhaustion may not only be arrested, but the crops be increased.

Attention has been directed also to numerous plants without any reputation as forage plants, but which, flourishing vigorously upon worn-out soils, are looked to as the means of the ultimate restoration of such lands to fertility by their employment in green manuring; a method which, with clover, rye, buckwheat. and other crops, has been productive of such excellent results—an unfailing and inexpensive resource, and often the only remedy within the means of the average farmer.

The determination to institute a thorough research in this direction has been very much encouraged by a recent conversation with that eminent chemist, Dr. St. Julian Ravenel, of Charleston, S. C. The results obtained in some experiments made by him in utilizing the vetch and the beggar-lice weed of Florida as preparatory forerunners for a crop of wheat in the sandy, barren flats near Charleston are so wonderful, that the experiments will need to be repeated under personal inspection several times before we can feel sure of such favorable results as the usual sequence to such simple means.

As there could be nothing more important, in an agricultural point of view, than a full, careful, and thoroughly scientific examination into the chemical composition of the various cereals of the country to determine their special qualities and comparative value, whether for the production of tissue, of fat, or of the fermentation-resisting characteristics which distinguish the milling products of some grains over others, I had directed such examination to be made by the chemist of this department; and the work had already begun when the limited force allowed in the chemical division and the more pressing importance of our experiments with sorghum and maize in the production of sugar (and which have just been referred to), made it apparent that investigation in that direction would necessarily have to be deferred to a "more convenient season."

So, too, of tobacco. Much useful information touching both the growth

and manufacture of this important staple—information which skillful chemical analysis can only determine—is necessarily withheld from the farmer and the manufacturer solely for the lack of force and facilities in the existing laboratory of this department. That the benefits which a thoroughly-equipped and sufficiently enlarged Chemical Division would confer upon all parts and nearly every industry of the country are not exaggerated, will to some extent appear from the following extracts from the letters of a few only of the many prominent scientists and distinguished agriculturists which have been addressed to the department on this subject. President Folwell, of the University of Minnesota, says:

I can only venture to suggest that the department would do well to collate from all sources all results of chemical investigations of use to the industrial interests of the country and publish them.

President Arnold, of the Oregon Agricultural College, remarks:

One thing I greatly desire to see done is this, viz., that some one competent make an abstract of all those principles pertaining to agriculture, both physical and chemical, upon which all scientific agriculturists are agreed.

Hon. Stephen L. Goodale, of Maine, for many years secretary of the State Board of Agriculture, says:

The vast benefits conferred by the experimental agricultural stations of Europe upon the people of that country, by unlocking stores of hitherto concealed information, should furnish hints for the right work here.

From Professor Seely, secretary of the Vermont Board of Agriculture, we read:

The collation and arrangement of what you have already done would be of the greatest value to the country.

President Welch, of the Agricultural College of Iowa, remarks:

I have long been of the opinion that the agricultural interests of the country would be greatly advanced by a more thorough analysis than has yet been made of the grains, grasses, and edible roots, in order to determine the exact value of each in the production of milk, beef, and fiber, or muscular power. Millions of dollars are annually wasted by hap-hazard feeding; and what we want, as seems to me, is more precise tatements, based on the scientific research of the chemist, as to the use of the various foods.

Professor Goessmann, of the Massachusetts Agricultural College, writes:

I believe a thorough examination into the chemical and industrial relations of our standard crops a very desirable investigation in the interest of national modes of farming.

Professor Nicholson, in behalf of Professor Holmes, of the University of East Tennessee, says:

A careful determination is needed of the comparative values of the different grades of wheat sold in, say, Baltimore or other markets; and, further, as to the chemical differences, if any, between the same variety of wheat grown in Alabama, Georgia, or Louisiana and in New England. That there is a practical difference every one knows, but precisely upon what it depends remains to be determined.

James O. Adams, secretary of the New Hampshire Board of Agriculture since its organization, writes as follows:

I find we are obliged to go, in a good degree, to Wolff and other Germans for what we want. Their analyses of grasses, &c., are generally the basis. It seems to me we ought to have full analyses of our plants, &c., by *our own* analysts.

Professor Swallow, of the University of Missouri, says:

I feel we need, most of all, knowledge of our food products, such as wheat, corn, barley, rye, and oats. As we live in the center of the great corn and wheat growing region of North America, we have commenced some experiments which we expect to continue for years. But we want *chemical analyses* to finish up our experiments.

Speaking of the enormous trade in commercial fertilizers, in which millions of dollars are annually expended, the Hon. H. Lewis, president of the New York State Agricultural Society, writes:

After giving the subject what attention I could, I have come to the conclusion that there is no way in which the Department of Agriculture can aid the farmers of this country more than by a careful analysis of the commercial fertilizers sold on the market. The use of these fertilizers has become a necessity in all the older States—a necessity which is to increase from year to year. There is not one farmer in five hundred thousand able to tell their value except by actual trial, and that must be made after his money is gone. I hope you will be able to aid us in this matter.

Prof. John B. Bowman, regent of the University of Kentucky, writes that, among other things within the province of the department,

There remain in the wide field for investigation the various soils, fertilizers, &c., to be examined.

President Phillips, of the University of North Carolina, says:

It seems to me that you will do our farmers most good by showing them how to defend themselves against fraud in what they buy as seeds, fertilizers, &c.

And further:

I learn from the great smoking-tobacco factory of W. P. Blackwell & Co., at Durham, N. C., that there is great room and great need for original chemical research in the important work of curing tobacco.

I might go on with similar quotations from leading citizens in almost every section of the country; but why multiply evidence already conclusive of the vast amount of good which the chemical division of this department would be capable of performing to a greatly increased extent if wider scope were given to its operations by more generous appropriations?

The insufficient force in the laboratory, and the small dimensions of the laboratory itself—two small rooms, a closet, and a small cellar for the furnace—has, as we have already seen, greatly hindered the experiments in the manufacture of tea and sugar inaugurated during the past summer and fall. Though defective, from these causes, as the experiments were, it has been thought advisable to submit them to the public, so that whatever hints they may afford to those contemplating an attempt in these industries the coming season may not be offered too late for adoption. It is well known and often remarked by people familiar with the facts that there are probably five hundred laboratories in the colleges and schools throughout the country greatly superior in equip-

ment and allotted space to that provided by the United States Government for its Department of Agriculture.

In concluding this branch of my report, it is pertinent to say that this department requires a working force of from 20 to 30 persons in the chemical division (it is now allowed but one chemist at the inadequate salary of $2,000, curtailed by reason of insufficient appropriation to $1,900 per annum, and one assistant chemist, whose salary has been curtailed for the like reason, from $1,600 to $1,400), and a suitable laboratory apart from the main building, to enable the force to work to the best advantage. Three hundred thousand dollars would build a laboratory sufficient for the requirements of the department for a number of years to come, which would be capable of doing much other work required by the different departments of the government and of various sections of the country. The need of such a laboratory is daily felt. The questions submitted by members of Congress, as well as officials of other departments of the government, which affect the public weal, could be promptly and definitely answered so far as present scientific knowledge will permit, and thus information of great importance and value to the people of the whole country could be furnished from an authoritative and official source.

In the establishment of the laboratory attached to this department, it was not, perhaps, designed that it should be used for private purposes to any great extent; and yet there is a vast amount of private work required, which, in a more liberal construction of the duties pertaining to this division, becomes of great public importance. Our country seems to be specially favored with minerals of all kinds, and there is scarcely a State or Territory in which there does not exist many having a fertilizing value. To determine, therefore, by careful analysis, the value of these articles, and give an official approval or condemnation of them, would seem to be a duty which this department owes to those engaged in the development of such resources, as all such developments add to the wealth of the nation, and the advancement, prosperity, and happiness of the people.

To more fully illustrate the importance of this proposition, I have but to refer to the work of this division as detailed in my last annual report and in this volume. In the analysis of the bat guanos of Texas, samples of which were forwarded from near Galveston, the report of the chemist for the year 1877 gives the per cent. of fertilizing material contained therein, and shows from the samples analyzed and the extent of the deposits that they represent a value of perhaps $20,000,000. These deposits are private property, and yet the subject becomes one of public importance to the locality in which they exist, as the vast sum here represented must, in a measure, be distributed among many classes of people.

HORTICULTURAL DIVISION.

The labors of the *Horticultural Division* during the past year have been very closely confined to the propagation and distribution of eco-

nomic plants, the number of which depends, as a matter of course, upon the amount of money appropriated to pay the necessary labor required as well as upon the restriction entailed by the limited area of land which is available for the nursery preparation of the hardier species of plants. The land embraced by the Agricultural Department grounds is largely occupied by an arboretum, which is highly instructive and ornamental, as befits the disposition of grounds surrounding public buildings in a great city.

A considerable portion is also occupied by the buildings and structures required for the proper administration of the duties of the department, such as stables, workshops, seed-houses, and greenhouses. Orchards containing select collections of pears and the small fruits, as well as a collection of hardy apples from Russia, further occupy the space, so that the amount available for testing seeds and for raising plants, vines, or trees for general distribution is not more than two acres in extent.

When we take into consideration the action of older and more experienced nations, the importance which they attach to each and every agricultural improvement, the ample support they give to all efforts which are directed toward the increase of the productions of the soil, by means of large experimental farms and stations for the solution of scientific questions, and which are maintained in various parts of their respective countries, our Agricultural Department and its resources seem entirely trivial and insignificant.

Occupying a country which possesses every variety of soil and climate, extending from the arctic north to the tropic south, and in which agriculture is by far the greater interest—that upon which all other industries depend; a country one-half of the inhabitants of which are directly engaged in agricultural pursuits, yet our government is far behind all other civilized nations in the encouragement it gives to agricultural pursuits and progress.

It is respectfully submitted that no more profitable expenditure of money could be made than that necessary to secure and maintain a farm of 1,000 acres near this city, and eight or ten experimental stations in various parts of the country, located so as to embrace extremes of latitude and climate, on the Pacific and Atlantic coasts, and in the Southern and Northern, as also the Middle States. This would enable the department to determine on a commensurate scale the value of seeds and plants for distribution throughout the country, as also to make such scientific and accurate tests in regard to fertilizers, rotative cropping, insect depredations, and the numerous and constantly increasing subjects suggested daily for the benefit of agriculture, as would enable it to meet the reasonable expectations of those who are practically interested, and who are anxiously beseeching the department for assistance in their agricultural and horticultural enterprises.

Facilities of this kind would aid in the introduction of tropical and

semi-tropical products, especially fruits, such as the orange, lemon, pine-apple, banana, guava, cherimoyer, &c., and such articles of common use as coffee and tea, and such textile plants as agave, bhœmeria, and others, which, although in some cases may be looked upon as doubtful experiments, are yet undetermined, and their values can only be learned from intelligently directed efforts.

The orange and lemon culture is of much promising importance, and in order to develop and increase the valuable collections now in possession of the department, a small house has been arranged and expressly devoted to their culture and propagation.

A distribution, as far as means would allow, has been made of the Japan persimmon, a fruit of great reputed value in its native country, and of prospective value here, particularly on account of its use in a dried state.

The olive has also received special attention. A valuable selection of the best known commercial varieties has been secured, and will be propagated as rapidly as means will allow. Much interest is felt in the culture of this product in the various States where the olive succeeds, and as the plant is not sensibly injured by less than a zero cold, it can be made a subject of experiment over a large portion of this country.

The culture of the Chinese tea plant is exceedingly promising. The agitation of this industry has had the effect of arousing the attention of a large number of planters, and evidence daily accumulates as to what has already been done with the plant as a domestic production, and mainly for local domestic uses. It is not to be expected that home production will, for many years to come, make itself felt in the foreign commerce of this article; but it may be expected connoisseurs will soon discover the merits of the domestic article, and will not be satisfied with the inferior foreign product.

This fact is apt to be overlooked in the discussion of this question, but the superiority of the home product will force itself upon the attention of consumers, for the experience of those who have used the tea of Georgia confirms the world-wide and popular assertion that "good tea as a beverage can only be had in tea-growing countries."

The operations consistently belonging to the Horticultural Division of this department are multiplied and important. In some degree these operations are misconstrued. It does not propose, as seems very generally presumed, to propagate flowers and fruits indiscriminately for distribution. It is not intended to propagate plants for the beauty of their flowers, except so far as may be required for direct use in the ornamentation of the department grounds. Plants valued merely for the beauty of their flowers are not included in the distributions proper of the department, these being confined to plants of economic value and utility.

During the year there has been distributed from the grounds 45,750 tea plants, 12,200 strawberry, 7,181 plants of oranges, figs, Japan persimmons, olives, &c., 2,954 grapes, and 95,000 scions of Russian apple trees.

BOTANICAL DIVISION.

The work of this division has been steadily prosecuted. During the winter distribution of specimens were made as follows: To each of the following colleges one box of specimens of the woods of the United States: State Agricultural College, Lansing, Mich.; University of Minnesota, Minneapolis, Minn.; State Agricultural and Mechanical College, New Orleans, La.; Rutgers College, New Jersey; also two boxes of wood sections to Massachusetts Agricultural College, Amherst, Mass.

To each of the following colleges one box of botanical specimens: Delaware College, Newark, Del.; Agricultural and Mechanical College, Lexington, Ky.; University of Wisconsin, Madison, Wis.; Virginia Agricultural and Mechanical College, Blacksburg, Va.; Agricultural and Mechanical College, Bryan, Tex.; Agricultural and Mechanical College, Columbus, Ohio; Agricultural and Mechanical College, Chapel Hill, N. C.; Agricultural and Mechanical College, Columbia, Mo.; Kansas Agricultural College, Manhattan, Kans.; University of Georgia, Athens, Ga.

Later in the year there have been sent to the Iowa Agricultural College one box of specimens of the woods of the Argentine Republic, and one box of botanical specimens; also to Wellesby College, Massachusetts, one box of specimens of woods of the Argentine Republic.

The botanical collections have been increased during the year by the receipt of one box of wood specimens from St. Petersburg, Russia; one box of botanical specimens collected by the Wheeler expedition and donated by the Smithsonian Institution; one package of Siberian and Japanese plants from the St. Petersburg Botanic Garden (also through the Smithsonian Institution); one box of botanical specimens from the Government of Spain; purchase and donation of a large collection of European mosses, the collection of the late Prof. Rudolphus Oldberg; and by purchase as follows: one set of Florida plants, from Dr. A. P. Garber; a quantity of Arizona plants, from Dr. E. Palmer, and one set of the ferns of Trinidad, from A. Fendler.

During the past summer the cases and herbarium have been transferred to rooms on the second floor, in connection with the general museum. New cases have been added, so that abundant room for the herbarium is now provided for several years to come. Additional interest and value have been given to the division by the erection of two large cases for the display of wood specimens, fruits, and objects of botanical interest.

The herbarium is increasing in public interest and value, and is now more frequently visited and consulted for purposes of instruction by teachers, professors in institutions of learning, and by private individuals interested in botanical pursuits.

MICROSCOPICAL DIVISION.

This division is principally engaged in the investigation of plant-dis

eases, the elucidation of the causes and tendency of plant-decay, and the discovery of a remedy, as well as the utilization of such cryptogams as can be made available for food, dye-stuffs, pigments, and other commercial purposes.

The following will illustrate the general character of the work of this division during the past year:

Investigations relating to the rust of cotton-plant.

The structural appearance of sugar made from sorghum and maize, as seen under the microscope, having relation to their starch, sugar, and general cell-contents during the process of ripening.

The diametric measurements of merino wool of various breeds, showing the comparative results and value of cross-breeds and high culture.

The structural examination of textile fibers, and other relative resisting power to chemicals, as seen under the miscroscope.

The cellulose of plants and fruits in relation to their amylaceous and woody condition, whether digestible or indigestible, as shown by the action of sulphuric acid in the conversion of cell-tissue into starch, as shown under the miscroscope.

The relation of dairy prime butter to oleomargarine, as seen under the microscope.

The characteristics of colored Demarara sugar, as shown by experiment under the microscope, at the request of the Treasury Department.

Experiments relating to insecticides.

Experiments relating to anti-fungoid solution.

The classification of the edible fungi of the United States, showing 165 species.

The investigation of sweet-potato rot, grape-rot, and quince-fungus.

The relative tendency of different varieties of potatoes to decay under adverse conditions.

The work of the Microscopist has, with a few exceptions, been confined to such investigations as could be conducted in the department.

ENTOMOLOGICAL DIVISION.

In this division, there has been greatly increased activity during the year. Its correspondence has become quite extensive, and aside from the numerous answers to communications regarding the names and habits of well-known injurious insects, and remedies for the same, many new species have been received and studied. While much has been added to our knowledge of a number of insects that may be considered of secondary importance only, from the fact that they are local rather than national in character, and while much valuable information regarding them, with remedies and suggestions for their destruction, will be included in the forthcoming report of the Entomologist, he has occupied himself more particularly with four classes of insects that seriously affect American productive industries for good or for evil. These are, 1st, cranberry-insects, about which many important facts have been learned;

2d, insects affecting the orange, and which so seriously threatened orange-culture in Florida; 3d, silk-worms; 4th, cotton-insects.

In my last annual report I gave statistics showing that we annually pay to foreign countries no less than twenty-three million dollars for silk, all of which, by proper encouragement of silk-culture in the United States, may in due time be saved to our people. A review of all past attempts at silk-culture in this country shows very clearly that the causes of failure have been transient and not permanent ones, and the very many letters that constantly come to the department, asking for information on the subject of silk-culture and for silk-worm eggs, indicate the increasing interest felt by our people in this branch of industry.

Last spring, through the courtesy of Mr. Lang Tsuda, a valued correspondent in Japan, the department was presented with a few cards of the eggs of a kind of silk-worm known as the *Yana Gawa*, a valuable race, producing a small white constricted cocoon. The worms were fed on three different species of *Maclura*, or Osage orange, and on eight different species of mulberry, as well as on some other allied plants, by way of experiment. Another race that has been fed for the last eight years on Osage orange by Professor Riley was also grown. A part of the silk from these worms has been reeled in this country by Mr. L. S. Crozier, of Silkville, Franklin County, Kansas, and proves to be of the very first quality. But the most interesting fact in connection with these experiments is that the silk produced from the Osage-orange race, which was originally a cross between the best French and Japanese worms, actually proved superior in quantity and equal in quality to that fed on mulberry.

It is gratifying to be able to state that this interest is beginning to receive attention, and that already systematic and intelligent effort is being displayed in the line of silk-raising in this country. Parties in North Carolina have found it sufficiently profitable, even with present drawbacks, to raise silk-worms, and ship the cocoons to France. One gentleman in Raleigh, Mr. E. Fasnach, has shipped two bales to Marseilles, each containing over 100 pounds of choked cocoons. These have been sold at Marseilles for as high as 32 francs (or over $6) per kilogram (not quite 2¼ pounds), and the freight from Raleigh to Marseilles did not exceed $3 per hundred weight. The cocoons were raised by the children of the family; and aside from the silk product, Mr. Fasnach also produced a number of eggs, for which there is now a ready market abroad at $3.50 to $4 per ounce (of 26 grams). Several other persons in different parts of the country have also reared sufficient quantities of cocoons to warrant New York brokers in offering from $1.50 to $2 per pound for the same. When parties find it profitable to raise silk under these adverse circumstances, there can be no question as to the growth of the industry whenever a home market is furnished for the raw material, and that when once it shall have been demonstrated that there can be offered and paid for cocoons some stated sum that will yet allow a fair profit on the

reeling, the industry will be fairly established, and private capital will not be wanting to seek profitable investment therein.

Mr. John Ryle, of Paterson, N. J., a well-known authority on this subject, writes me under recent date as follows:

> The right way is to start every family to raise a few cocoons, and to prepare the way to provide a market for them, and so induce our people to increase the quantity raised, until there is enough to employ regular filatures, and professional reelers, to produce silk for our own factories. This can only be the work of time, but there is no other way to accomplish this result.

There can be no question as to the adaptation of the larger part of our country to silk-culture, or of our ability to grow the worms successfully. Experience has established these two facts, as it has the superior quality of American-grown silk. It is not so necessary to urge the cultivation of the mulberry as it is to establish first a market for the cocoons. In some parts of the South the best of white mulberries are already grown in large orchards, for the sake of the fruit, which is deemed most valuable food for hogs, and in case the mulberry-trees already grown should at any time be cut off by mildew and disease, as they were at the close of the multicaulis fever in 1839 and 1840, we have the advantage over Europe and other countries in being able to fall back upon the *Maclura*, which proves, when judiciously fed, to be as good as mulberry.

Pursuant to an appropriation made by the last Congress for the purpose, I have carried on a special investigation of the insects injurious to the cotton-plant, more particularly the cotton-worm (*Aletia Argillacea*). The investigation so far (notwithstanding the lateness of the season when the work was commenced, and the unfavorable condition of the Lower Mississippi Valley, for such an inquiry the present year) has been fruitful beyond expectation. It is my desire and intention to make the investigation thorough and exhaustive. To accomplish this and to do full justice to the subject will require continuous work to the end of the next cotton-season, as we cannot arrive at complete knowledge on the many questions that present themselves, whether regarding the habits of the insect, or as to the best means of preventing its injuries, without pursuing systematic investigations through every season of the year. I will therefore hope and expect a renewal of the special appropriation for this purpose to enable the department to satisfactorily complete the work. When we reflect on the immense losses the cotton-grower has sustained during the best part of a century from the ravages of the cotton-worm and other insects, it is surprising that no systematic investigation had before been made by the government; and now that the investigation has been commenced, it is very desirable that it be completed in a thorough manner.

STATISTICAL DIVISION.

This division has been employed during the past year, as usual—

In collecting the statistics of farm products and animals through the agency of some 4,000 correspondents;

In the recording and tabulation of foreign statistics, compiled from the data supplied by those governments and by their agricultural societies;

In supplying the demand for information from members of Congress, boards of trade, and persons interested in agriculture, manufactures, and commerce;

In recording the prices of farm products and animals in the leading markets of the United States;

Also, in publishing a monthly report of the crops of the whole country, giving a detailed statement each month of acreage, condition, and quality of each crop, thereby reaching thousands of persons who otherwise would have to depend upon unreliable sources for such information; and I can only regret that the limited amount of the appropriation for statistical purposes does not permit a more extended report of labor, wages, and other matters of interest to agriculturists and to the whole country.

The report of the crops for the present year presents no material change from the abundant crop of 1877, which has been equaled, and in some cases surpassed, by the crops of this year.

The acreage in corn was slightly increased, while the condition during the growing season was not quite as favorable. Still the crop this year will be one of the largest ever grown, and will, in the aggregate, equal its predecessor of 1877. This is the more remarkable, as this is the fourth of an unbroken series of large crops.

The wheat crop of the present year promised in the spring to be unusually large. The winter had been favorable, the acreage largely increased, and the growing condition all that could be desired, but the "hot wave" of July brought disaster to the crop in certain portions of those States where spring wheat is sown, and in which the grain was in that certain condition of growth rendering it liable to be affected by the simoom, which lasted three days, and ruined the hopes of thousands. The States that produced the heaviest yield last year produced the lightest this; yet, in a general view, it is to be considered that in the States north, and bordering on the Ohio River, in Kansas, Nebraska, and California, there are large yields reported, larger considerably than last year, so that the crop of this year may be safely estimated at twenty-five millions of bushels greater than that of 1877.

The other grain crops have been generally good, presenting no new feature this year. The only crop which shows a material decline is the potato crop, which is from twenty to twenty-five per cent. less than that of last year. This great decline was owing to the extreme heat of July and the drought of August.

The cotton crop, so important in its bearing on the industries of the world, has been favored during all the stages of its growth. The acreage was slightly increased—about 2 per cent. The absence of insect injuries was almost universal, only small portions of Mississippi, Ala

bama, and Georgia reporting any. The increase of product per acre is very decided, only Florida, Alabama, and Louisiana reporting a slight decrease, while Texas, Arkansas, and Tennessee report large gains. Should the season continue favorable for the next fortnight the crop will all be saved, and the total will exceed 5,000,000 bales.

The tobacco crop does not promise so large a yield this year as last, but the quality is much superior. Later returns are necessary before any estimate of the quantity can be made.

The prospects for the sugar and rice crops of the South are very encouraging, particularly the former. Last year was one of disaster, but the favorable weather this fall promises an unusual result—much greater than the product of last year.

The following table presents the number of persons engaged in the different occupations in the United States at the last enumeration:

Population.	1870 (census).		1878.	
		Per cent.		Per cent.
Total over 10 years	28, 228, 945	....	34, 000, 000	....
Males in all occupations	12, 505, 923	....	15, 000, 000	....
Agriculture	5, 922, 471	47. 35	7, 600, 000	50. 66
Manufacturing and mining	2, 707, 421	21. 65	2, 900, 000	19. 33
Professional and personal	2, 684, 793	21. 47	3, 000, 000	20. 00
Trade, commerce, and transportation	1, 191, 238	9. 52	1, 500, 000	10. 00

The census of 1870 gives an aggregate value of all personal and real property for that year of $29,822,535,140.

The agricultural interest being valued at 38 per cent. of all others combined, the value of farms and property is $11,124,959,037.

Value of farms, 1870	$9, 262, 803, 861
Value of farm animals, 1870	1, 525, 276, 747
Value of farm implements, 1870	336, 878, 429
Total	11, 124, 959, 037

The increase of population over 10 years was somewhat above 21 per cent. At the same rate of increase of values the value of farms and farm products for 1878 would be as follows:

Value of farms, 1878	$11, 207, 992, 671
Value of farm animals, 1878	1, 845, 584, 863
Value of farm implements, 1878	407, 622, 899
Total	13, 461, 200, 433

The value of farm products and animals for the year 1870 was returned at $2,447,558,658. Production has increased and prices have declined, and we estimate the total production of 1878 at about $3,000,000,000.

I desire again to call attention to a comparative statement of the appropriation made for the different departments of government, and

with this purpose reproduce the following statement embraced in the last annual report, and now corrected in some particulars:

It is shown by a recent statement made from the records of the Treasury Department that the total expenditures of the Department of Agriculture from 1839 to 1877, inclusive, amount to $3,366,114.37. From this amount should be deducted $100,000 appropriated in 1867 for the purpose of enabling the Commissioner of Agriculture to erect a department building, and the further sum of $50,000 appropriated for the printing of the annual reports of the department for the years 1872 and 1873, and erroneously charged to the current annual expenses of the department for those years. Deducting these two items from the above amount, and it leaves the sum of $3,216,-114.37 as the aggregate amount appropriated during the existence of the government for the promotion of agriculture. The utter insignificance of this sum becomes apparent when compared with the amounts appropriated for the maintenance of other departments of the general government. Dividing the total amount appropriated by the number of years during which these appropriations have been made, and it gives the small sum of $84,634 as the average annual expenses of the department. When it is remembered that the last census established the fact that one-half the population of the United States is either directly engaged in agricultural pursuits or is wholly dependent upon them for support, this sum becomes still more insignificant as an appropriation for fostering and promoting so vast an interest.

The following appropriations for the years named will be sufficient to illustrate the difference in the amounts appropriated for the various departments of the general government.

Departments.	1877.	1878.	1879.
Department of State	$1, 377, 428 43	$1, 353, 807 50	$7, 134, 325 64
Treasury Department	163, 015, 647 68	159, 222, 392 61	167, 122, 213 75
War Department	37, 251, 271 81	4, 245, 628 00	68, 263, 792 48
Navy Department	13, 115, 176 55	13, 745, 422 90	20, 684, 492 83
Interior Department	37, 673, 054 17	36, 674, 573 32	38, 245, 551 74
Post-Office Department	6, 422, 283 49	3, 469, 045 00	7, 295, 389 98
Department of Justice	3, 364, 343 31	3, 424, 950 00	3, 918, 913 94
Department of Agriculture	174, 686 96	188, 640 00	204, 900 00

The following table exhibits, in a condensed form, the appropriations made by Congress for this department, the disbursements and unexpended balances for the fiscal year ending June 30, 1878:

Title of appropriation.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Salaries	$65, 640 00	$65, 640 00	....
Collecting statistics	15, 000 00	15, 000 00	....
Purchase and distribution of seeds	75, 000 00	74, 579 33	*$420 67
Experimental garden	4, 000 00	4, 000 00	....
Museum and herbarium	1, 500 00	1, 500 00	....
Furniture, cases, and repairs	4, 500 00	4, 500 00	....
Library	1, 000 00	1, 000 00	....
Laboratory	1, 000 00	1, 000 00	....
Contingent expenses	8, 000 00	8, 000 00	....
Postage	4, 000 00	3, 445 21	554 79
Improvement of grounds	6, 500 00	6, 500 00	....
Printing and binding	9, 000 00	8, 807 59	192 41
Forestry	2, 500 00	2, 500 00	....

*The unexpended balance of the appropriation for purchase and distribution of seeds will be exhausted in the settlement of a bill not yet determined to be paid from that appropriation.

DISEASES OF DOMESTICATED ANIMALS.

During the past twenty years, or more, the spread of infectious and

contagious diseases among domesticated animals in this country has been very rapid, and increasingly malignant and destructive. So wide-spread and fatal had many of them become that I determined, a year ago or more, to institute a preliminary investigation looking to a discovery of the cause and a remedy for some of the more virulent and destructive of these maladies. No funds being available for this purpose, all that could be done was to open a correspondence with leading stock-raisers throughout the country, hoping thereby to elicit information touching the annual losses of farm stock from the various diseases incidental to this class of property, the character of the maladies most prevalent and fatal, and what remedies, if any, were used. A large number of circular letters were forwarded to the regular correspondents of the department, and to many others engaged exclusively in stock-raising. Replies were received from every section of the country. These letters contained much valuable information, which was called for by resolution of the United States Senate, February 20, 1877, and by you forwarded to the President of the Senate on the 27th day of the same month. (See Ex. Doc. No. 35, Forty-fifth Congress, second session.) By reference to this volume, a few copies only of which were printed, a tabular statement will be found which gives returns of annual losses of domesticated animals in 1,125 counties out of 2,447, the whole number of counties contained in the United States.

These returns are as accurate as could be given in the absence of an absolute census, but for less than one-half the Territory of the United States they show annual losses amounting to $10,091,483 in swine alone, and for all other classes of domesticated animals the losses are given for the same counties at $6,561,945, making a grand total of $16,653,428.

These figures indicate that the losses of farm animals throughout the United States annually aggregates the sum of $30,000,000 or more. As at least two-thirds of this amount seemed to be sustained in the loss of swine from affections which appeared to be but little understood by the farmer and stock-raiser, I regarded the subject of sufficient importance to call for an appropriation to defray the expenses of a scientific investigation into the causes of many of the more malignant, infectious and contagious diseases of domesticated animals, but more especially of those incident to swine.

The sum of $10,000 was appropriated for this purpose, and as soon as the fund was available examiners were appointed in the States of New York, Indiana, Illinois, Iowa, Kansas, Missouri, and North Carolina. These examiners were instructed to devote the brief time allotted them to an investigation of diseases of swine, as I did not regard the amount of the appropriation sufficient to cover the additional expense of an investigation of infectious and contagious diseases incident to other classes of farm animals.

By reference to the returns above alluded to it will be seen that th annual losses of swine are heaviest in some of the above-named States,

and hence it was deemed advisable to confine the investigation to those States and localities where the disease was most extensive, virulent, and fatal. I have more recently appointed an examiner for Virginia, who has devoted a portion of his time to an examination of a fatal disease prevailing among cattle in some of the northern and northeastern counties of that State, and who pronounces the disease pleuro-pneumonia.

Previous to the beginning of this examination and investigation, every disease incident to swine was known as "hog-cholera," but the examiners, whose reports are now being prepared, will show that this class of farm stock is subject to almost as many different and distinctly marked diseases, and of equally as malignant, contagious, and fatal a character, as those which afflict mankind. Their reports will also show the identity of these diseases as they annually prevail in the great corn-growing and pork-raising regions of the country, and will demonstrate the absolute necessity of a continuation of this investigation until definite results are obtained as to the causes of these disorders, and the discovery of remedies for the same. In addition to the saving of so vast an amount of property, the health of our people demands the completion of this work, as it is a noteworthy but lamentable fact that many herds of hogs are shipped to the nearest market, or are slaughtered by the owner for marketable purposes, as soon as disease makes its appearance among them. I shall therefore ask for an additional appropriation by Congress to enable me to carry forward and, if possible, complete this investigation.

One of the most dreaded contagious diseases known among cattle is that of pleuro-pneumonia or lung fever. It was brought to this country as early as the year 1843, and has since prevailed to a greater or less extent in several of the Eastern and a few of the Southern States. It made its appearance about a century ago in Central Europe, and has since spread to most European countries. With the exception of rinderpest it is the most dreaded and destructive disease known among cattle. Unlike Texas cattle-fever, which is controlled in our more northern latitudes by the appearance of frost, this disease "knows no limitation by winter or summer, cold or heat, rain or drought, high or low latitude." It is the most insidious of all plagues, for the poison may be retained in the system for a period of one or two months, or even for a longer period, in a latent form, and the infected animal in the mean time may be transported from one end of the continent to the other in apparent good health, yet all the while carrying and scattering the seeds of this dreaded pestilence.

Since the appearance of this affection on our shores it has prevailed at different times in the States of Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, and in the District of Columbia. It has recently shown itself at two points in Virginia (Alexandria and Lynchburg), where it was recently prevailing in a virulent form.

At present the disease seems to be circumscribed by narrow limits, and could be extirpated with but little cost in comparison with the sum that would be required should the plague be communicated to the countless herds west of the Alleghany Mountains. This disease is of such a destructive nature as to have called forth for its immediate extirpation the assistance of every European government in which it has appeared, many of them having found it necessary to expend millions of dollars in its suppression. The interests involved in this case are of so vast a character, and of such overshadowing importance both to the farming and commercial interests of the country, as to require the active intervention of the Federal Government for their protection, and for this reason the considerate attention of Congress is respectfully asked to this important matter.

THE PARIS EXPOSITION OF 1878.

The United States having been invited by the Republic of France to take part in a universal exposition of the productions of agriculture, manufactures, and fine arts, to be held at Paris in 1878, an appropriation of $150,000 was made by Congress December 15, 1877. This sum was subsequently increased by another appropriation to $190,000. Out of the sum first appropriated $10,000 was assigned to the Department of Agriculture as its proper proportion of the fund, with which to make a display of the agricultural productions of this country. From the second appropriation of $40,000 made toward the close of the second session of the Forty-fifth Congress the department received $5,000 additional for this exhibit.

The first appropriation was not available until some weeks after the approval of the bill, and the exposition was to open about the 1st of May, thus leaving a very short time and, that at an unpropitious season, in which to collect, prepare for exhibition, and transport such productions of our agricultural industry as would do credit to the country.

Every effort was made that the limited time and meager means would permit to make such an exhibition as would attract attention of the people of all nationalities, and thus enlarge the markets for the consumption of our products. Our exhibition of agricultural production, though not by any means such as could have been made, or such as would have been made had more time and money been devoted to it, was in some degree creditable to the country, and has received the approval and commendation of the French authorities and the people of other countries who attended the Exposition.

The former chemist of the department, Dr. McMurtrie, was especially charged with the care of this exhibit; but as he has not yet returned or reported thereon, more particular mention of the part which the Agricultural Department has taken in the Paris Exposition is left for a subsequent report.

FORESTRY.

The former Report on Forestry, from the limitations placed upon its extent, did not contain all the matter that was prepared for publication. An additional work has therefore been prepared, under my direction, by Dr. Franklin B. Hough, Commissioner of Forestry, which it is desirable shall be published as a companion to the former report.

Of the first report it may suffice to say that it has attracted general attention and gained the highest commendation from the most distinguished authorities on forestry, and also from those interested in the industries resulting from forest products in other countries. Their special journals reproduce extracts or full translations of important articles, and manifest great interest in our discussions relating to the extent, management, and maintenance of our forest supplies.

The manuscript now prepared contains ample information upon the subject of forest resources of other countries, a subject which was necessarily excluded from the former report; it embraces much recent information concerning the changes going on in special institutions for instruction in forestry; it reviews the proceedings of various American societies for the promotion of agriculture and horticulture, so far as they discuss questions relating to forest planting and management; it includes several special memoirs upon scientific investigations in this direction, the methods of management, and other subjects of unquestionable importance that have not hitherto appeared in the English language.

In the prosecution of this investigation Dr. Hough, during the past fall, visited the British Provinces of Canada, availing himself while there not only of the various official reports bearing on the subject, but of the co-operation and advice of many persons who, from official position or special qualification, were best able to promote the object of his visit. That the publication of this supplementary report will prove of value there is no room whatever to doubt, the whole question of forestry and timber being one of vast and vital interest to the entire country.

This volume, if published, will contain about as many pages as the Report on Forestry published in 1877, and it is a very valuable compilation, which ought to be published as a second volume of Agricultural Report for 1878, and 300,000 copies could be distributed with profit to the business of the country.

This subject of Forestry is of so great and immediate importance to our people that it is my duty to again urge the appropriation of the small sum of money ($6,000) asked for last year, for continuing this work of Dr. Hough, and for obtaining other facts and information preparatory to establishing a Division of Forestry in this department.

Of the science of Forestry, so far as relates to the management of State domains for the growth of timber, the care of property owned by communes and public institutions, but under public authority, the rights of common usage, and all the laws, regulations, and judicial decisions

relating thereto, we shall never have in the United States much practical interest, because the circumstances under which landed property is held in this country are altogether different.

The title of our lands is allodial, and the owner absolutely owns all the rights belonging to the soil, subject only to the right of eminent domain, when the government sees fit to assert it, and to the obligation or assisting by taxation in the support of government. The codes and jurisprudence of Europe, so far as they relate to Forestry, are, therefore, of little concern in the future management of our woodlands; and all the special training bestowed upon young men, in qualifying them for the administration of these interests, would, so far as relates to legal provisions and the various remedies that they provide against the evasion or violation of these laws, be lost upon one intending to devote himself to tree-culture with us.

But we have, nevertheless, much to be considered as regards legal provisions for the encouragement of planting, and already in many of the States premiums and exemptions have been allowed, some of which, being ill-advised and full of mischief, have already been repealed. In other States some protection may be needed which has not been given; and in the future we need a means for carefully collecting and presenting full and reliable information for the guidance of State legislatures, to the end that nothing be neglected that their true interests may require, and that there be no more blunders to correct. The Forestry report of 1877 gave the principal laws that had been passed up to that time for the encouragement of forest-tree planting; that of 1878 will give all that have since been enacted, with a careful inquiry into the causes which have in some cases led to the repeal of bounties formerly granted. It should be the duty of the person having charge of this inquiry to report annually upon this subject, in order that a uniform standard of excellence in regard to legislation upon this subject may be reached and maintained.

But let it not be inferred that we can learn nothing from European experience upon the management of forests. On the contrary, we have everything to learn and apply, that this experience can teach us, with regard to methods and management, and to the scientific researches that are being made for the discovery of principles, and the operation of natural laws, for the advancement of the interests depending upon Forestry.

There are over twenty Schools of Forestry in Europe, in which this subject is taught in the most thorough manner, in all its relations to science and its applications to the planting, management, and renewal of forests. The professors in these schools have, in many instances, prepared special memoirs upon subjects of practical interest, and some of these schools, as at Tharandt, Neustadt-Eberswalde, Nancy, Hohenheim, &c., have published from year to year information of practical interest in every country where trees can be grown. At most of these schools, ex-

perimental stations have been established, not merely for the instruction of their students but for original investigations that shall extend the boundaries of knowledge beyond their former limits, and discover facts that may be turned to practical account in cheapening methods of management or increasing the value of products. The best of these results should every year be judiciously digested and prepared for publication for the benefit of our own citizens.

At some of these stations, especially in Prussia and Bavaria, the government has instituted a series of comparative observations for the study of the climatic effects of woodlands upon agriculture, and those in charge of these systems have expressed an earnest wish for coöperation in the United States. Among the agricultural colleges already established through Congressional patronage, and at several of the meteorological stations maintained at the national expense, these observations could be established at very little expense beyond the cost of instruments. It should be the duty of the person charged with the study of Forestry to organize, direct, and unify these observations, and to digest and publish their annual results.

It should be remembered, in this study of climatic effects, that the general humidity of our atmosphere is much less than that of Europe, for the reason that the westerly winds prevailing in both regions pass over the Atlantic influenced, in some cases in notable degree, by the Gulf Stream before reaching Europe, while our westerly winds have their moisture largely condensed before passing far inland, by being carried over high mountain ranges, so that in their further course over vast regions they yield no further moisture as rain, and the surface remains arid, and in many places not susceptible to cultivation. Hence the conclusions to which European observations might lead would not find application with us; and if we would know the laws that govern our climate, and the influences that may tend to ameliorate or impair it, we must work out the problem ourselves.

There are about twenty journals wholly devoted to Forestry published in various parts of the world. Of these, British India, Russia, Sweden, Denmark, England, France, Austria, Spain, and Italy have each one, Switzerland two, and Germany the remainder. There cannot be a doubt but that every one of these contains every year much new information that would have practical application, and that would lead to useful results in this country if known. Some of these journals are distinguished for the ability with which they are conducted, and, passing over all that is local or special, a great deal of general interest to our citizens. This information should be judiciously prepared and given to our people for their benefit. Besides these special journals of Forestry, the transactions of learned societies, and the scientific journals of more general field, often contain articles of practical interest. This is especially true of those devoted to the study of natural history; the injuries done by noxious insects and their remedies; the preservation of timbers; the

manufacture of woods and wood products; and various topics of inquiry that have relation to this subject.

Passing from these studies of the sciences of exact observation to those of a business-like character, there are from time to time brought forward new methods of working and management, which are urged upon the public under an interest that seeks profit from their use. It is unfortunate that these novelties have not always the merit which they claim, and that while some are really worthy of public attention, there are others that deserve no notice. A discriminating and impartial statement of what is really worthy of notice might prevent inconsiderate investments in others that are not. It would be especially desirable to know concisely the results reached by commissions appointed from time to time for testing alleged discoveries or new methods, as is done more or less every year by various European governments and by commissions appointed by learned societies.

In almost every country in Europe, but especially in Germany, associations of foresters have been formed, solely for the discussion of questions of professional interest. If a new disease or injury to young seedlings, or to nurseries or plantations of larger growth, has appeared, all experience is combined and all science is exhausted in the discovery of its cause and in the application of the remedies. The comparative merits of methods of culture and management, the effect of fertilizers, and the various circumstances that can be controlled, so far as they affect the interest under protection, are fully discussed and compared. Most of these associations publish annually, or more frequently, the results of their labors, and not a little of these would be useful, if known to our people. The meeting of German foresters at Dresden during the last summer has been mentioned as one of unusual interest.

The number of publications devoted to various questions specially relating to Forestry that appear every year in Europe, besides those already referred to, is large. In Germany alone the number is sometimes a hundred a year. Not a few of these possess unusual interest, and the best results of these labors in the field of scientific research or applied knowledge should be known wherever they can be applied. In fact, we cannot afford to let these new principles pass unobserved and unapplied while so much can be saved or gained by availing ourselves of their use.

Turning from this field of experimental inquiry and observation in foreign countries to our own, we have in various sections of the country, but especially in the prairie regions of the West, a large amount of useful observation every year accumulating, which should be gathered up and made known. It should be remarked that every new discovery is not valuable, nor will what may be applicable in one region be useful to another. This negative knowledge is often of great value by preventing unwise investment and consequent losses; as, for example, in attempting to cultivate in one locality some species that has proved highly successful in another, where a full knowledge of all the conditions requi-

site for success would have shown beforehand that the enterprise would fail.

There are also from time to time various economies proposed in the use of forest products, some of which would prove of great advantage if generally known. In other cases opportunities now neglected might be improved, if pointed out; and, generally, an able, diligent, intelligent, and impartial study of the various subjects having relation to Forestry cannot fail of resulting in lasting benefit to the country, and to all classes having occasion to produce, sell, or use forest products. This, either, directly or incidentally, may be said to include all classes of our citizens, and to affect in greater or less degree every interest in the country.

I subjoin a few extracts from very many commendatory notices of the volume on Forestry, which show the estimate in which the report is held and the desirability, not to say necessity, of the continuance of effort in this direction.

The New York Times, of date July 10, 1878, after noticing the efforts made by the Secretary of the Interior to prevent timber depredations throughout the United States, says of this report:

The subject is a broad one and well worthy the attention of all thoughtful men. It rises above politics, and should not, as it was last winter, be discussed in a partisan or sectional spirit; the whole country is vitally interested in the cultivation of the forest lands of the West and South.

The St. John's Printers' Miscellany, of June, 1878, says:

Report upon Forestry is the title of a very valuable work laid upon our table through the kindness of the Hon. W. G. LeDuc, United States Commissioner of Agriculture. The author, Dr. Hough, has certainly fulfilled his commission on this important subject in a very painstaking and exhaustive manner, and from the nature of the information conveyed in its pages the work should be placed in the hands of every farmer, at least, on this continent.

It might not be amiss to suggest here that the Dominion Government should appoint a like commission, for this is a subject which affects the most vital interests of the country at large.

The Western New York Ruralist says:

Of this report we do not know how the newspapers could do the country better service than by scattering broadcast among the farmers of the land portions of the information here gathered. The timber resources and timber needs of different parts of the country, the methods of tree-planting and tree-pruning, the sanitary and climatic effect of woodlands, the need of timber-belts for farm and fruit protection, valuable forest products, and many other important subjects are treated at length.

The Maine Farmer says:

Those who are acquainted with the great acquirements of Dr. Hough, with his familiarity with almost every subject of historical and scientific inquiry, with his great diligence, and his fine, clear style, need hardly to be told that the entire work has been well done. It is much to be regretted, however, that from want of a sufficient appropriation, a vast collection of statistical information of great historic and economic value, as well as many useful illustrations and diagrams, were obliged to be wholly omitted, while the work was so limited in size that much matter of importance had to be entirely left out. But as it is, it is one of the most important works ever issued by the government.

The Journal of Forestry and Estate Management, published at London, after speaking in high terms of the report of Dr. Hough, and the diligent manner in which he has prosecuted his investigations, says:

From these sources he has been able to collect an astonishing amount of useful information, which he has arranged with laudable carefulness and great ability in the report now before us.

The report was limited to a volume not exceeding 650 pages, which has compelled the author to condense or exclude much valuable matter; but still the book is compiled in such a masterly manner that it forms the most complete and exhaustive treatise upon the subject that has yet appeared in the English language. For the present we would recommend the careful study of it to all arborists, who will find in it a perfect mine of information calculated to instruct and interest all students of the science and art of forestry.

The Pioneer Press of Saint Paul says:

The Report on Forestry, by Dr. F. B. Hough, issued under the direction of the Commissioner of Agriculture, is a work of great value. The author seems to have prosecuted his inquiries with industry and intelligence, not only throughout the United States, but in foreign countries. It is indeed in foreign countries where the vital importance of preserving forests has been long understood, and where for many years they have been fostered under settled policies of the various governments, that we can learn most of the vital necessity of forest culture, and of the means best adapted to promote on a large scale the growth of woods and to preserve those which still survive the tremendous havoc and waste which are making in all our native forests.

The following is an extract from a letter written by Prof. Andrew Llaurado, of the School of Forestry, Escura, Madrid, Spain:

I know your name by your excellent work in the Report upon Forestry. I appreciate the extent of your knowledge and the wisdom of your government in charging you with the duty of writing upon so important and interesting a subject.

Prof. W. S. Clark, president of the Massachusetts State Agricultural College, says:

I have just examined with pleasure your important Report upon Forestry, and hope your good work may be continued.

Jos. L. Budd, Professor of Forestry, Iowa State College, says:

I have received your very valuable Report on Forestry. It is a matter of extreme regret that this report could not be generally disseminated, and especially in the West. It is the only valuable and original work on this vitally important subject.

DISTRIBUTION OF SEEDS.

The organic law establishing the department, and which has not been changed or modified in this respect, makes it the duty of the Commissioner to confine (sec. 526) "purchase and distribution of seeds by the Department of Agriculture to such seeds as are rare and uncommon to the country, or such as can be made more profitable by frequent changes from one part of our country to another," &c.

By these express terms it becomes as much the duty of the Commissioner to distribute as to purchase these seeds. Both purchase and distribution are devolved on him alone. But, for reasons not now apparent, the distribution came in time to be transferred from the department very largely into the hands of members of Congress, a division of the seed

being made in the rooms of the department and sent to members at their several residences in Washington, during the sessions of Congress.

The result of this saving of trouble and shirking of responsibility by the Department of Agriculture was that members of Congress were either overwhelmed with the burden of a personal distribution and a personal response to letters on the subject, at a time when legislative duties were most pressing, or had to be at the expense of a clerk for this purpose, or else were obliged to transmit the packages as received to postmasters and political friends in their respective districts, to be by them subdivided and further distributed—usually where they would do the greatest political rather than agricultural good.

As illustrating the manner in which I at one time hoped to correct this serious evil and the causes which have so far hindered its complete adoption and full effect, I beg leave to quote from a letter addressed, in February last, to certain members of Congress, as follows:

On assuming the duties of Commissioner of Agriculture, I found that the distribution of seeds as heretofore conducted had grown outside of the law to an evil of serious magnitude; that, in contravention of the manifest purposes for which the department was created, it had included not more of "new and valuable" seeds than of the commonest kinds already in use, and which could be bought in almost every seed-store, not to say country grocery; that it had been extended so as to embrace almost every manner of applicant, not less the country merchant whose object was to sell at retail, than the *bona fide* cultivator of the soil; that it was prejudicial to agriculturists themselves, lulling them into an indifference about raising their own seeds—the only safe and judicious plan; and last, but not least, that it was (and was so pronounced by many of their number) a great, unnecessary, and unwarranted tax on the time, attention, and patience of members of Congress. To relieve them of this onerous burden, and to bring the action of the department in the matter strictly within the intent and letter of the law, I determined to pursue the policy indicated in the circular issued July, 1877, and which I had the honor to submit to the consideration of members of Congress.

In this circular, issued, as will be seen, before the assembling of the present Congress, I requested its members to designate the best men, in an agricultural sense, in their respective districts, to receive "new and valuable" seeds, to be sent out by the department. Not only this, but at the request of many members of Congress, the department undertook to reply to letters written to them, in which application had been or should be made for seeds, and to send the seeds to those applicants whom they would vouch for, and nominate as intelligent and worthy agriculturists; and, furthermore, would answer the letters of those whose requests could not be granted, stating to the applicant the reason therefor, and citing the law on the subject.

A majority of the members have furnished lists, and the seeds have been sent in accordance therewith. Had I been able to adhere strictly to this course, much of the evil spoken of would, in my judgment, have been eliminated from the pre-existing practice. But it has now become apparent that the clerical force of the department is inadequate to such a task, and I am, therefore, reluctantly compelled to remit, in many cases, to members of Congress, the burden of which they have complained, making it optional with them either to take the seeds to their rooms and themselves to be the distributors thereof, or else to leave it with the department to make the distribution among those to whom, under the plain construction of the law, it was intended they should be sent.

Thus, for want of clerical aid, I am forced for the time to forego the line of action I had mapped out, and must of necessity content myself with the hope that it will gradually but surely become the undeviating practice, as it is and should be the undoubted

policy of the department; unless, indeed, some other and better course can be devised to moderate the demands of applicants, and confine to legitimate bounds a distribution which has proved of so great value to the country, even in the imperfect manner in which it has heretofore been done.

The views here expressed I have seen no reason to change in any essential particular. The necessity still exists, and must always exist, that this matter of distributing seeds shall be confined, equally with the duty of purchasing them, solely to this department; and I am pleased to say that a large majority of the members of Congress, whose opinions have been sought, signify not only their assent but their earnest desire to be relieved from this onerous tax on their time, by the relegation of the labor to the proper party.

They see, as the department does, and as all impartial observers must, that an important purpose for which this department was created, to wit, accurate experiments attending the introduction of new varieties of seeds, and intelligent reports on the same, leading to the elimination of the valuable from the valueless, can be reached in no other way than by having the department to be the sole distributor of the seeds which are to be placed in the hands of agriculturists, and the single depository of all reports from the recipients of them—reports which are to be the basis of future distribution, and guides to the agriculturists in every portion of the country. Already there are organized in the department separate divisions charged with the work of gathering such reports from all parts of every State in the Union, eliminating from them all valuable information—information shaped by inquiries pointedly directed—and filing the same in convenient form for future reference. Unless we can get such reports, and have them convenient for reference, and thus know the results flowing from our distribution, the distribution of seeds at all is of doubtful value, and might as well be abandoned.

Only by obeying the organic law, which requires the *Commissioner of Agriculture* to distribute to *agriculturists* the seeds which invite them, can we hope to obtain these reports with any degree of certainty. This law is mandatory and must be obeyed until Congress shall see fit to amend the same, and thus permit or prescribe some other method of distribution.

Of the thousands and thousands of dollars' worth of seeds that have passed through the hands of members of Congress, it is safe to say that not a dozen reports have ever been made that have been available to the department as data on which to determine the intrinsic value of the seeds which have been drawn from its supply, or of the causes leading to failure or to success, as the case may have been, in the various localities where they were tried.

This one fact furnishes all the argument necessary to give emphasis to the importance of a strict adherence to the law, which enjoins that the distribution be made by the Commissioner of Agriculture and only to agriculturists.

The question of the value to the *farmers* of the country, and relatively

to the country itself, of the distributions of seeds which have been made by this department—if there be any serious question in the minds of really intelligent men on the subject—would seem to be fairly met and fully answered in the many letters received daily from all sections bearing ample testimony to the importance of what has already been done, and calling for further help. A few of these letters are appended as illustrating the general tone of them all. It will be seen that wherever a marked increase of crops has occurred the result has been attributed generally to the new or improved varieties of seeds which had gone forth into those sections from this department, and that wherever a better system of cultivation has been inaugurated it is stated to have been greatly stimulated by the principles inculcated and the information contained in the numerous reports of the Department of Agriculture. Not infrequently do correspondents volunteer the statement that the seeds which we have sent them have increased the yield of crops from one-tenth to one-fourth, and in some instances an hundred-fold. Not the least of many resulting benefits, they say, will be found in the more mixed and varied husbandry which the introduction of new seeds has made possible; the greater number of crops rendering the farm more self-supporting, and materially lessening the danger of total loss, as is often the case where cultivation is confined to one or two staple crops.

The following extracts from our correspondents indicate the almost invariable tone of the letters which are received on this subject:

ALABAMA.—A correspondent says: "The wheat sent me by the department possesses value above gold, and an adaptation above any other variety."

ARKANSAS.—"The variety of wheat from the department yields more and suits this people better than any other ever tried here." Another: "The winter rye sent here by the department is highly satisfactory, and has doubled the yield of that grain in the county." Another: "The oats are a great improvement on any others ever grown here, and are the best in every particular."

CONNECTICUT.—"The wheat sent us by the department is the admiration and wonder of all the farmers; the best ever raised here."

INDIANA.—"The introduction by the department of improved varieties of wheat has been worth thousands of dollars to our county."

KANSAS.—"The two wheats sent here by the department are very valuable and a great acquisition." Another: "The winter oats have largely increased the yield and crop in this State."

KENTUCKY.—"The new wheats sent from the department are superior and more popular, giving better satisfaction than any we have ever grown." Another: "The oats are very productive and fully successful."

MAINE.—"Wheat from the department is valuable, yields 16 to 22 bushels per acre; average of the entire State before only 14 bushels." Another: "Oats from the department prove to be just what we want."

MARYLAND.—"The wheat introduced by the department is very valuable; the best raised here; yields much above the average."

MICHIGAN.—"Wheats from the department yield well, from 15 to 40 bushels, much above the average, which is 13½ bushels per acre." Another: "The new oats are satisfactory, altogether the best raised here."

MISSISSIPPI.—"Oats introduced by department have been a great advantage to this section."

MISSOURI.—"The introduction of improved wheats by the department has been of great value by increasing our crop."

"NEBRASKA.—"The wheats from the department gave great satisfaction, yielding from 13 to 40 bushels to the acre; much above past average." Another: "The corn is a valuable acquisition; the best grown here."

NORTH CAROLINA.—"The introduction by the department of improved varieties of wheat has been the means of largely increasing the production of that crop in these counties."

PENNSYLVANIA.—"The wheat sent from the department has made a decided improvement in the yield and quality of our wheat crop, and given great satisfaction." Another: "Since the distribution of the two varieties of oats by the Agricultural Department, our oat crop has been nearly doubled, both in quantity and weight of the bushel."

SOUTH CAROLINA.—"The wheat sent from the department is beautiful, gives large yield, nearly free from rust; greatly increasing our crop, and we want more of it."

VIRGINIA.—"All are well pleased with the new varieties of wheat from the department; have much increased our yield." Another: "The yield ranges from 14 to 40 bushels per acre; the average in past years has been from 8 to 10½ bushels per acre." Another: "The pecuniary advantage to our State from the improved oats is greater than the entire annual appropriations for the Agricultural Department." Another: "The value of the new potatoes sent to our State is worth more in benefits to us than the whole cost of the department."

WISCONSIN.—"The improved varieties of oats, wheat, and barley sent to our State from the department are a most valuable acquisition, and have largely increased our crops."

A comparison of the statistics of production at different dates shows that there has been an *increase in average yield* per acre of wheat, corn, oats, and other crops; much of this is without doubt due to the use of seeds of improved varieties of those grains *distributed by the department* during the last decade. For instance, in 1870, the average yield per acre in the United States was, of wheat, 12.4 bushels; of Indian corn, 28.3 bushels; of oats, 28.1 bushels; and correspondingly so with other crops. In 1877, the average yield per acre of the same crops was, of wheat, 13.9 bushels; Indian corn, 28.6 bushels; oats, 31.6 bushels. Total yield or crop of wheat in 1870 was 235,884,700 bushels; of Indian corn, 1,094,255,000; of oats, 247,277,400. Yield of same crops in 1877 was, wheat, 364,194,146; of Indian corn, 1,342,558,000; of oats, 406,394,000; showing a general increase in the seven years of about 50 per cent. Analyzing these facts will show results in localities as follows:

The average yield per acre of the two Carolinas, in 1870, was, of wheat, 7.8 bushels; in 1877, 9.1 bushels. Of Minnesota, in 1870, 15.2 bushels; in 1877, 18.5 bushels. Virginia, 1870, 9.6 bushels; 1877, 10.4 bushels. Pennsylvania, 1870, 12 bushels; 1877, 13 bushels. Georgia, 1870, 8 bushels; 1877, 9.5 bushels. Showing an increased average product in the States named ranging from 1 to 3 bushels per acre, adding millions of dollars to our annual values.

Of purchases and of distributions which have been made and not hitherto reported, I would remark that in the summer of 1877 I purchased in Hungary, and imported to this country, some of the celebrated wheat called Sandomirka, the flour of which has long commanded the highest price throughout all Europe, and is also imported into the United States for certain special purposes. This wheat had the reputation for very many years of being the best grown in that country.

This importation was distributed with great care in the fall of the same year. With the exception of two or three localities in Tennessee and one in North Carolina, the results have been unfavorable; but whether, after being acclimated in this country, it will not prove to be a profitable and valuable grain, can only be determined after further experiment.

Other new varieties of winter wheat, such as the Golden Straw, Arnold's Gold Medal, Sandford and Silver Chaff, were also distributed in the fall of 1877; in all about eleven hundred bushels. Extracts from the returns made regarding these varieties will be appended.

For the spring sowing the present year, there were distributed the following varieties: Golden Globe, Defiance, Champlain, and Sherman, a total of 420 bushels, the Golden Globe largely preponderating; the result of this distribution of spring wheat will likewise appear in appended extracts.

Twelve hundred bushels of other varieties of winter wheat, viz., Mold's White, Mold's Red, Yellow Missouri, Victor, Swamp, and Midge-proof, with three hundred bushels of the previously tried Silver Chaff, have been distributed during the fall of the present year. These will all be reported upon after the next summer's harvest.

A variety of oats, named (from some circumstance attending their importation and purchase) "The Board of Trade," and probably of Norwegian origin, distributed in a small way last season (spring, 1878), has proven to be of great value to the country, and wherever tried has uniformly produced large crops, the grain weighing from 35 to 40 pounds per bushel. It has been a very decided success.

There were also distributed of winter oats, obtained mainly from Tennessee, about 470 bushels.

Of rye there were sent out in the fall of 1877 about 350 bushels, known as White Winter Rye; of barley, at the same period, 400 bushels of a six-rowed variety; and 100 bushels of a spring variety, the past season, called Mensury, distinguished for its early ripening and excellent malting qualities; of Silver Hull buckwheat, 164 bushels.

Tabular statement showing the quantity and kind of seeds distributed by the seed division, Department of Agriculture, from July 1, 1877, to June 30, 1878, inclusive.

Name of seeds.	Varieties.	Quantity.	To whom sent. Senators and members of Congress.	Agricultural societies.	Statistical correspondents.	Granges.	Miscellaneous.	Total.
Vegetable	123	Papers	420, 856	43, 157	52, 535		152, 786	669, 334
Flower	246	...do	132, 368	40			69, 189	201, 597
Herb	7	...do	5				10	15
Tree	10		256				1, 442	1, 698
Tobacco	5		46, 100	220			10, 835	57, 155
Opium poppy	1		57				291	348
FIELD SEEDS.								
Wheat	9	Quarts	7, 823	13, 204	16, 004	1, 358	12, 287	50, 676
Oats	2	...do	3, 144	4, 648	6, 064		3, 309	17, 165
Barley	2	...do	1, 250	2, 164	8, 248	1, 614	1, 443	14, 719
Rye	3	...do	694	98	5, 436		958	7, 186
Buckwheat	3	...do	459		3, 474	1, 304	366	5, 603
Field corn	5	...do	4, 709	676	6, 090	1, 360	3, 642	16, 477
Field pease	1	...do					48	48
Sugar-beet	5	...do	2, 457	900		272	1, 135	4, 764
Mangel-wurzel	2	...do	316	16			286	618
Broom-corn	1	...do	1, 358	24			239	1, 621
Doura	2	...do	32				20	52
Potatoes	6	...do	1, 907	6, 010	17, 284	5, 664	3, 109	33, 974
Rice	1	...do	2				16	18
Grass	4	...do	3, 051		5, 248		3, 689	11, 988
Clover	2	...do	1, 135	8	8		1, 559	2, 710
Vetch	1	...do	24				25	49
Millet	1	...do	356					356
Sorghum	2	...do	3, 313	28		1, 610	2, 784	7, 735
Chufa	1	½ pints	3, 560			952	3, 348	7, 860
Tea-seed	1	Quarts	7	100			1, 197	1, 304
TEXTILES.								
Cotton	1	Quarts	146				193	339
Hemp	1	...do	76				26	102
Flax	1	...do	5				5	10
Jute	1	...do	28				87	115
Ramie	1	Papers	36				214	250
Grand total	456		635, 530	71, 293	120, 391	14, 134	274, 538	1, 115, 886

Tabular statement of seeds distributed by the seed division, Department of Agriculture, from July 1, 1878, to November 30, 1878.

Description of seeds.	To whom sent. Senators and members of Congress.	Statistical correspondents.	Agricultural societies.	Selected farmers.	Miscellaneous persons.	Total.
Vegetable ... papers	532	26, 966	12, 308		6, 916	46, 722
Ramie ... do					10	10
Tree-seed ... do	31		100		3, 983	4, 114
Tobacco ... do					164	164
Opium poppy ... do					28	28
Wheat ... quarts	4, 890	12, 587	5, 408	25, 230	5, 899	54, 014
Oats ... do	460	4, 719		14, 252	750	20, 181
Rye ... do	206				294	500
Grass ... do	10			20	289	319
Sorghum ... do					81	81
Buckwheat ... do	32			20	290	342
Millet ... do					4	4
Chufa ... do					27	27
Sugar-beet ... do	4				11	15
Vetches ... do					2	2
Doura ... do					3	3
Corn ... do					5	5
Rice ... do					7	7
Hemp ... do					9	9
Potatoes ... do					201	201
Grand total	6, 165	44, 272	17, 816	39, 522	18, 973	126, 748

Reports of these, as of many other seeds enumerated in the preceding tabular statement, will likewise be found in the appendix, and are well worthy the attention of the agriculturist, who, as a rule, is more interested in detailed operations and special results than in general theories and deductions.

IMMEDIATE NECESSITIES OF THE DEPARTMENT.

The immediate necessities of this department, beyond the appropriations usually made for its ordinary working, may be stated:

1. A laboratory of proper size and fully equipped, to cost not less than $300,000, with a sufficient appropriation to meet the expenses of the additional force that will be necessary to carry forward investigations on a larger scale than the present laboratory and appliances will permit; an increased appropriation for the salary of the chemist, and the further sum of $5,000, made available immediately, to pay for labor and material necessary in the pressing work of this division.

2. An experimental farm of one thousand acres of ground, in the neighborhood of this city, and five experimental stations in different sections of the country, viz., one in California; one in the interior of the continent (to be devoted to the introduction and preservation of the best breeds of domesticated animals and to the domestication of some of the native wild animals of the country, among them the buffalo); one in Texas; one in Florida, and one in New York above the latitude of Albany. To inaugurate these farms a large sum will not be necessary, and after the first year the expense will be more than paid by the results of the cultivation at each station.

3. An increased appropriation for the gardens and grounds of the department, which embraces experimental cultivation and propagation of trees, plants, &c., for distribution. This appropriation should be increased to at least $15,000.

4. An increased appropriation of $3,000 for obtaining new material, employing labor, and otherwise extending the benefits arising from the museum and botanical divisions of this department.

5. A renewal of the appropriation of $10,000 for the examination of the diseases of domesticated animals—a work already partially accomplished.

6. A renewal of the appropriation of $5,000 for continuing the investigation of the history and habits of insects injurious to agriculture, especially those injurious to the cotton-plant—a work already partially completed; and the further sum of $5,000 to pay the necessary salaries and contingent and traveling expenses of observers employed in such duty, and also such additional compensation, not exceeding one thousand dollars per annum, to the entomologist of the department.

7. An additional appropriation of $6,000 to continue the work on forestry.

8. An appropriation of $5,000 to erect a stable suitable for the housing and protection of the stock used on the department grounds.

Very respectfully, your obedient servant,

WILLIAM G. LEDUC,
Commissioner of Agriculture.

EXPLANATIONS AND REMARKS ON THE TABLES.

In making thorough examination of the question of sugar production in the United States, a collateral inquiry has resulted in information which is appended to this prefatory report at this time, for the attention not only of the legislative powers of the country, but of all those interested in commercial transactions with sugar and its allied products.

This tabular statement of the tariff on sugar, extending from 1790 to 1877, inclusive, compiled with care, has been subjected to such revision as, I believe, entitles it to the confidence of those who wish to investigate this subject, or to predicate legislation thereon.

The tabular statement of the imports, exports, cost, and consumption of tea and coffee was prepared at the same time and with like care, and is worthy of attention.

The *Imports* and *Exports* are taken or compiled from the "American State Papers" and the statistics of "Commerce and Navigation."

The "*Difference*" is obtained by subtracting the exports from the imports, or the reverse; if the export item exceeds the import item, a minus sign is used to designate such excess.

"*Value*" signifies the difference between the value of the imports and the value of the exports, and is therefore the cost of what is consumed. From 1867 to the present date the amounts in the value column are quoted from the statistics of "Commerce and Navigation."

"*Price*," or "*Average price per pound*," is obtained by dividing value by the quantities in the column of foreign consumption.

The annual amounts "*Paid for customs*" from 1867 until date are quoted or compiled from the statistics on "Commerce and Navigation"; previous to that year they are found by multiplying the quantity consumed by the rate of duty on each kind or grade of the article under consideration. For instance, tea is classified under various names, with a specific rate of duty on each; also, refined sugar comprises different grades, with a corresponding variety in the rates of duty.

The "*Rate*" or "*Average rate of duty*" is the result of dividing the *Paid for customs* by the amount consumed.

The column of *Domestic produce* is estimated and collected from various sources, and, although not absolutely correct, forms the best known data of the sugar produced in the United States.

The figures in *Domestic exports* are quoted from the "American State Papers" and statistics of "Commerce and Navigation."

Previous to 1867, *Foreign consumption* is deduced from the imports and exports; after that time the amounts are taken from the tables of home consumption in the statistics of "Commerce and Navigation."

Domestic consumption, previous to 1867, is the difference between domestic production and exports; subsequently, the amounts are copied from the statistics of "Commerce and Navigation."

Total consumption and *Average per capita* are interesting and important, as showing the rate of increase in the consumption of tea, sugar, and coffee with the increasing population, also the fluctuations from year to year caused by changes in the tariff laws or by wars or other disturbances.

TABLE I.—*Imports, exports, cost, and consumption of tea*

Years.	Foreign.			Value of tea consumed.		
	Imports.	Exports.	Difference.	Average price per pound.	Value.	Average rate of duty.
FIRST DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1790	3, 022, 983	(chests,) 1, 672				
1791	1, 305, 428	(chests,) 2, 923		[8] .27		
1792	[1] 2, 670, 103	(chests,) 1, 609				
1793	[1] 2, 204, 446	49, 938	2, 154, 508			
1794	[1] 2, 623, 265	109, 005	2, 514, 260			
1795	2, 705, 839	(chests,) 1, 621				
1796	2, 491, 083	135, 328	2, 355, 755			.150
1797	1, 919, 111	132, 350	1, 786, 761			.175
1798	2, 073, 055	178, 687	1, 894, 368			.197
1799	4, 589, 593	96, 861	4, 492, 732			.175
SECOND DECENNIUM.						
1800	5, 119, 340	1, 180, 632	3, 938, 708			.209
1801	3, 823, 709	1, 409, 253	2, 414, 456			.213
1802	4, 234, 376	1, 894, 538	2, 339, 838	[8] .263	617, 348	.207
1803	6, 411, 534	3, 146, 492	3, 265, 042	[8] .450	1, 469, 977	.188
1804	3, 190, 828	1, 219, 233	1, 971, 595	[8] .548	1, 082, 195	.260
1805	5, 072, 248	1, 788, 888	3, 283, 360			.241
1806	7, 019, 450	2, 002, 202	5, 017, 248			.250
1807	7, 601, 612	2, 663, 061	4, 938, 551	[8] .675	3, 308, 829	.231
1808	5, 420, 587	237, 883	5, 182, 704			.255
1809	1, 471, 534	1, 770, 616	—299, 082			
THIRD DECENNIUM.						
1810	7, 708, 208	1, 337, 732	6, 370, 476			.241
1811	2, 850, 200	1, 025, 962	1, 824, 238			.246
1812	3, 074, 285	519, 254	2, 555, 031			.260
1813	831, 726	129	831, 597			.545
1814	202, 226		202, 226			.506
1815	2, 397, 891	128, 203	2, 269, 688	[8] 1.24	2, 882, 502	.481
1816	3, 100, 709	493, 960	2, 606, 749			.537
1817	7, 076, 346	917, 703	6, 158, 643			.363
1818	6, 349, 133	1, 831, 946	4, 517, 187			.366
1819	7, 189, 084	1, 564, 830	5, 624, 254			.370
FOURTH DECENNIUM.						
1820	[2] 6, 082, 365	1, 094, 584	4, 987, 781			
1821	4, 975, 646	389, 423	4, 586, 223	.235	1, 080, 264	.366
1822	6, 639, 434	1, 333, 846	5, 305, 588	.216	1, 160, 579	.366
1823	8, 210, 010	1, 735, 076	6, 474, 934	.239	1, 547, 695	.366
1824	8, 920, 507	1, 148, 868	7, 771, 639	.286	2, 224, 143	.378
1825	10, 209, 548	3, 035, 808	7, 173, 740	.313	2, 246, 794	.385
1826	10, 108, 900	2, 804, 753	7, 304, 147	.334	2, 443, 587	.401
1827	5, 875, 638	1, 626, 417	4, 249, 221	.221	942, 439	.405
1828	7, 707, 427	1, 417, 846	6, 289, 581	.281	1, 771, 255	.396
1829	6, 636, 790	1, 033, 995	5, 602, 795	.273	1, 531, 460	.394
FIFTH DECENNIUM.						
1830	8, 609, 415	1, 736, 324	6, 873, 091	.222	1, 532, 211	.389
1831	5, 182, 867	526, 186	4, 656, 681	.227	1, 057, 528	[3] .382
1832	9, 906, 606	1, 279, 462	8, 627, 144	.241	2, 086, 339	.279
1833	14, 639, 822	1, 712, 779	12, 927, 043	.369	4, 775, 081	[4] .289
1834	16, 282, 977	3, 081, 308	13, 201, 669	.388	5, 126, 265	.10
1835	14, 415, 572	2, 082, 866	12, 332, 706	.291	3, 595, 281	.10
1836	16, 382, 114	1, 896, 342	14, 485, 772	.308	4, 473, 647	.10
1837	16, 982, 384	2, 508, 386	14, 473, 998	.345	5, 004, 542	.10
1838	14, 418, 112	2, 435, 302	11, 982, 810	.213	2, 561, 251	.10
1839	9, 349, 817	1, 592, 033	7, 757, 784	.230	1, 785, 649	.10

in the United States for each fiscal year from 1790 *to* 1878.

Value of tea consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*			*Pounds.*		*Pounds.*	*Number.*	*Ounces.*
							3, 929, 214	
							4, 049, 247	
							4, 172, 945	
				2, 154, 508		2, 154, 508	4, 300, 425	
				2, 514, 260		2, 514, 260	4, 431, 802	
							4, 567, 292	8. 54
354, 884				2, 355, 755		2, 355, 755	4, 706, 926	
313, 866				1, 786, 761		1, 786, 761	4, 850, 718	
374, 000				1, 894, 368		1, 894, 368	4, 998, 706	
787, 347				4, 492, 732		4, 492, 732	5, 151, 117	
824, 319				3, 938, 708		3, 938, 708	5, 308, 483	
514, 971				2, 414, 456		2, 414, 456	5, 475, 385	
484, 614	1, 101, 962			2, 339, 838		2, 339, 838	5, 647, 854	
614, 514	2, 084, 491			3, 265, 042		3, 265, 042	5, 825, 758	
512, 886	1, 595, 081			1, 971, 595		1, 971, 595	6, 009, 469	
791, 574				3, 283, 360		3, 283, 360	6, 198, 858	8. 37
1, 258, 863				5, 017, 248		5, 017, 248	6, 394, 211	
1, 145, 466	4, 454, 295			4, 938, 551		4, 938, 551	6, 595, 71[illegible]	
1, 247, 991				4, 883, 622		4, 883, 622	6, 803, 567	
							7, 018, 007	
1, 537, 480				6, 370, 476		6, 370, 476	7, 239, 881	
449, 245				1, 824, 238		1, 824, 238	7, 449, 832	
661, 453				2, 555, 031		2, 555, 031	7, 665, 973	
453, 343				831, 597		831, 597	7, 888, 280	
102, 403				202, 226		202, 226	8, 117, 036	
1, 093, 018	3, 975, 520			2, 269, 688		2, 269, 688	8, 352, 429	6. 37
1, 399, 911				2, 606, 749		2, 606, 749	8, 595, 645	
2, 236, 470				6, 158, 643		6, 158, 643	8, 845, 887	
1, 654, 370				4, 517, 187		4, 517, 187	9, 103, 354	
2, 085, 677				5, 621, 254		5, 624, 254	9, 365, 460	
				4, 987, 781		4, 987, 781	9, 638, 453	
1, 680, 122	2, 760, 386			4, 586, 223		4, 586, 223	9, 917, 091	
1, 946, 526	3, 107, 105			5, 305, 588		5, 305, 588	10, 205, 555	
2, 373, 855	3, 921, 550			6, 474, 934		6, 474, 934	10, 504, 195	
2, 941, 470	5, 165, 613			7, 771, 639		7, 771, 639	10, 813, 777	8. 67
2, 764, 590	5, 011, 384			7, 173, 740		7, 173, 740	11, 132, 991	
2, 934, 923	5, 378, 510			7, 304, 147		7, 304, 147	11, 459, 903	
1, 722, 111	2, 664, 550			4, 249, 221		4, 249, 221	11, 803, 775	
2, 491, 381	4, 262, 636			6, 289, 581		6, 289, 581	12, 157, 956	
2, 207, 873	3, 739, 333			5, 602, 795		5, 602, 795	12, 508, 898	
2, 674, 099	4, 206, 310			6, 873, 091		6, 873, 091	12, 866, 020	
1, 783, 372	2, 840, 900			4, 656, 681		4, 656, 681	13, 205, 429	
2, 408, 056	4, 494, 395			8, 627, 144		8, 627, 144	13, 615, 826	
376, 709	5, 151, 790			12, 927, 043		12, 927, 043	14, 019, 343	
182	5, 126, 447			13, 201, 669		13, 201, 669	14, 420, 731	11. 70
107	3, 595, 388			12, 332, 706		12, 332, 706	14, 814, 243	
99	4, 473, 746			14, 485, 772		14, 485, 772	15, 270, 483	
828	5, 005, 370			14, 473, 998		13, 473, 998	15, 711, 264	
407	2, 561, 658			11, 982, 810		11, 982, 810	16, 120, 891	
976	1, 786, 625			7, 757, 784		7, 757, 784	16, 599, 492	

TABLE I.—*Imports, exports, cost and consumption of tea in the*

Years.	Foreign.			Value of tea consumed.		
	Imports.	Exports.	Difference.	Average price per pound.	Value.	Average rate of duty.
SIXTH DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1840	20, 006, 595	3, 123, 496	16, 883, 099	. 240	4, 067, 144	. 10
1841	11, 560, 301	660, 832	10, 899, 469	. 287	3, 134, 147	. 10
1842	15, 692, 094	2, 290, 686	13, 401, 408	. 264	3, 538, 383	. 10
1843	[5]13, 869, 366	1, 080, 389	12, 788, 977	. 266	3, 406, 261	[6] Discriminating duty on certain imports, 10 per cent. ad valorem.
1844	15, 656, 114	2, 311, 952	13, 344, 162	. 239	3, 193, 376	
1845	19, 812, 500	2, 483, 368	17, 329, 132	. 278	4, 834, 601	
1846	19, 993, 747	3, 020, 135	16, 973, 612	. 235	3, 990, 455	
1847	17, 336, 654	3, 074, 270	14, 262, 384	. 224	3, 206, 750	
1848	23, 662, 969	2, 883, 531	20, 779, 438	. 255	5, 300, 377	
1849	16, 475, 873	3, 116, 890	13, 358, 983	. 224	3, 003, 939	
SEVENTH DECENNIUM.						
1850	29, 872, 654	1, 673, 063	28, 199, 591	. 141	3, 982, 054	
1851	17, 461, 114	3, 956, 340	13, 504, 774	. 255	3, 452, 501	
1852	29, 437, 206	3, 849, 538	25, 587, 668	. 231	5, 927, 143	
1853	22, 721, 745	3, 429, 861	19, 291, 884	. 364	7, 024, 526	
1854	24, 417, 712	5, 181, 599	19, 236, 113	. 256	4, 933, 553	
1855	25, 333, 097	5, 569, 504	19, 763, 593	. 249	4, 937, 610	
1856	22, 889, 850	4, 708, 380	18, 181, 470	. 288	5, 250, 603	
1857	20, 367, 824	3, 867, 539	16, 500, 285	. 263	4, 344, 963	
1858	32, 995, 021	4, 228, 444	28, 766, 577	. 204	5, 877, 387	
1859	29, 268, 757	6, 149, 468	23, 119, 289	. 213	4, 927, 178	
EIGHTH DECENNIUM.						
1860	31, 696, 657	5, 369, 729	26, 326, 928	. 263	6, 930, 124	
1861	26, 419, 956	5, 101, 289	21, 318, 667	. 257	5, 499, 569	
1862	24, 795, 983	1, 531, 644	23, 264, 339	. 254	5, 921, 401	.15 and .20
1863	29, 761, 037	2, 739, 997	27, 021, 040	. 258	6, 981, 050	. 20
1864	37, 472, 161	1, 378, 154	36, 094, 007	. 278	10, 045, 960	. 20
1865	19, 568, 318	2, 719, 129	16, 849, 189	. 179	3, 043, 933	. 25
1866	42, 992, 738	1, 481, 290	41, 511, 448	. 253	10, 510, 296	. 25
1867	39, 892, 658	513, 084	39, 379, 574	. 317	[7]10, 839, 327	. 25
1868	37, 843, 612	2, 217, 749	35, 625, 863	. 318	11, 948, 111	. 25
1869	43, 754, 354	2, 944, 329	40, 810, 025	. 329	12, 889, 383	. 25
NINTH DECENNIUM.						
1870	47, 408, 481	4, 868, 010	42, 540, 471	. 303	12, 386, 973	. 25
1871	51, 364, 919	6, 469, 974	44, 894, 945	. 303	14, 274, 489	. 20
1872	63, 811, 003	4, 441, 401	59, 369, 602	. 312	10, 710, 187	. 15
1873	64, 815, 136	1, 060, 196	63, 754, 940	. 357	38, 058, 769	. 15
1874	55, 811, 605	1, 670, 252	54, 141, 353	. 386	21, 050, 244	. 15
1875	64, 856, 899	1, 565, 595	63, 291, 304	. 349	22, 644, 841	. 15
1876	62, 887, 153	1, 726, 908	61, 160, 245	. 310	19, 503, 885	. 15
1877	58, 347, 112	1, 508, 937	56, 838, 175	. 272	16, 089, 241	. 15
1878	....	....	....	....	....	....

[1] These imports are for calendar years, and not fiscal years.
[2] Estimated by taking the mean between 1819 and 1821, there being no statistics of imports on record for this year.
[3] According to act of Congress May 20, 1830, discriminating duties were laid on teas as to their importation in foreign vessels, or from places east of the Cape of Good Hope.
[4] All teas imported from places east of the Cape of Good Hope in United States vessels shall be exempt from duty; otherwise imported, 10 cents per pound. Act July 14, 1832.

United States for each fiscal year from 1790 *to* 1878—Continued.

Value of tea consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*			*Pounds.*		*Pounds.*	*Number.*	*Ounces.*
2, 231	4, 069, 375	....	....	16, 883, 099	....	16, 883, 099	17, 070, 240	
12, 738	3, 146, 885	....	....	10, 899, 469	....	10, 899, 469	17, 563, 990	
16, 119	3, 554, 502	....	....	13, 401, 408	....	13, 401, 408	18, 065, 813	
63	3, 406, 324	....	....	12, 788, 977	....	12, 788, 977	18, 603, 956	
3, 636	3, 197, 012	....	....	13, 344, 162	....	13, 344, 162	19, 102, 946	
2, 501	4, 837, 102	....	....	17, 329, 132	....	17, 329, 132	19, 640, 029	12. 29
712	3, 991, 167	....	....	16, 973, 612	....	16, 973, 612	20, 225, 760	
669	3, 207, 419	....	....	14, 262, 384	....	14, 262, 384	20, 869, 760	
384	5, 300, 761	....	....	20, 779, 438	....	20, 779, 438	21, 609, 554	
2, 705	3, 006, 644	....	....	13, 358, 983	....	13, 358, 983	22, 358, 293	
12, 744	3, 994, 798	....	....	28, 199, 591	....	28, 199, 591	23, 191, 876	
9, 646	3, 462, 147	....	....	13, 504, 774	....	13, 504, 774	23, 974, 993	
11, 996	5, 939, 139	....	....	25, 587, 668	....	25, 587, 668	24, 843, 547	
3, 083	7, 027, 609	....	....	19, 291, 884	....	19, 291, 884	25, 721, 956	
1, 241	4, 934, 794	....	....	19, 236, 113	....	19, 236, 113	26, 615, 328	
2, 607	4, 940, 217	....	....	19, 763, 593	....	19, 763, 593	27, 586, 113	12. 566
3, 932	5, 254, 535	....	....	18, 181, 470	....	18, 181, 470	28, 349, 746	
498	4, 345, 461	....	....	16, 500, 285	....	16, 500, 285	29, 124, 515	
44, 605	5, 921, 992	....	....	28, 766, 577	....	28, 766, 577	29, 966, 042	
7, 431	4, 934, 609	....	....	23, 119, 289	....	23, 119, 289	30, 685, 586	
11, 015	6, 941, 139	....	....	26, 326, 928	....	26, 326, 928	31, 443, 321	
11, 660	5, 511, 229	....	....	21, 318, 667	....	21, 318, 667	32, 238, 403	
2, 887, 221	8, 808, 622	....	....	23, 264, 339	....	23, 264, 339	32, 987, 985	
5, 401, 455	12, 382, 505	....	....	27, 021, 040	....	27, 021, 040	33, 211, 430	
7, 170, 204	17, 216, 164	....	....	36, 094, 007	....	36, 094, 007	33, 345, 224	14. 25
4, 212, 297	7, 256, 230	....	....	16, 849, 189	....	16, 849, 189	33, 394, 882	
10, 377, 862	20, 888, 158	....	....	41, 511, 448	....	41, 511, 448	34, 324, 665	
[7]8, 533, 804	19, 373, 131	....	....	[7]34, 135, 215	....	[7]34, 135, 215	35, 342, 849	
9, 414, 664	21, 362, 775	....	....	37, 545, 734	....	37, 545, 734	36, 361, 669	
9, 785, 439	22, 674, 822	....	....	39, 141, 756	....	39, 141, 756	37, 400, 130	
10, 203, 047	22, 590, 020	....	....	40, 812, 189	....	40, 812, 189	38, 558, 371	
8, 322, 995	22, 597, 484	....	....	46, 972, 788	....	46, 972, 788	39, 723, 755	
5, 133, 674	15, 843, 861	....	....	34, 224, 493	....	34, 224, 493	40, 967, 095	
46, 656	38, 105, 425	....	....	106, 423, 570	....	106, 423, 570	42, 265, 762	
48, 173	21, 098, 417	....	....	54, 410, 055	....	54, 410, 055	43, 456, 931	21. 95
31, 712	22, 676, 553	....	....	64, 708, 079	....	64, 708, 079	44, 588, 083	
13, 677	19, 517, 562	....	....	62, 744, 429	....	62, 744, 429	45, 687, 668	
18, 509	16, 107, 750	....	....	58, 941, 178	....	58, 941. 178	46, 761, 551	
....	....	....	....	....	....	....	47, 874, 485	

[5]These statistics are from October 1, 1842, to June 30, 1843, nine months.

[6]According to act of Congress August 30, 1842.

[7]After 1867, inclusive, the consumption of tea, its value, and duty paid on it, are taken from the Annual Reports on Commerce and Navigation. Previous to that year the difference between the imports and exports are considered as consumption, and the value and duty are calculated on this difference.

[8]Previous to 1820, the price per pound of the imports is taken, and not the average price per pound of the difference. The prices of 1807 and 1815 are quoted from "Pitkin's Commerce of the United States."

TABLE II.—*Imports, exports, cost, and consumption of coffee*

Years.	Foreign.			Value of coffee consumed.		
	Imports.	Exports.	Difference.	Price per pound.	Value.	Rate of duty.
FIRST DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1790	4, 074, 125	284, 752	3, 789, 373			.025
1791	4, 478, 676	962, 977	3, 515, 699	[8].129	453, 525	.040
1792	[1]8, 566, 441	2, 136, 742	6, 429, 699			.040
1793	[1]34, 458, 178	17, 580, 049	16, 878, 129			.040
1794	[1]37, 281, 041	33, 720, 983	3, 560, 058			.040
1795	53, 960, 976	47, 443, 179	6, 517, 797			.050
1796	61, 141, 001	62, 385, 117	— 1, 244, 116			.050
1797	49, 491, 502	44, 521, 887	4, 969, 615			.050
1798	57, 722, 625	49, 580, 927	8, 141, 698			.050
1799	29, 978, 570	31, 987, 088	— 2, 008, 518			.050
SECOND DECENNIUM.						
1800	47, 389, 951	38, 597, 479	8, 792, 472			.050
1801	57, 383, 904	45, 106, 494	12, 277, 410			.050
1802	40, 882, 861	36, 501, 998	4, 380, 863	[8].218	955, 028	.050
1803	[2]17, 138, 493	10, 294, 693	6, 843, 800	[8].224	1, 533, 011	.050
1804	53, 278, 029	48, 312, 713	4, 965, 316	[8].231	1, 146, 987	.050
1805	55, 541, 320	46, 760, 294	8, 781, 026			.050
1806	55, 993, 788	47, 001, 662	8, 992, 126			.050
1807	58, 824, 811	24, 122, 573	34, 702, 238	[8].280	9, 716, 626	.050
1808	37, 035, 353	7, 325, 448	29, 709, 905			.050
1809	35, 517, 007	24, 364, 099	11, 152, 908			.050
THIRD DECENNIUM.						
1810	30, 869, 884	31, 423, 477	—553, 593			.050
1811	30, 062, 366	10, 261, 136	19, 801, 230			.050
1812	28, 265, 823	10, 073, 722	18, 192, 101			.050
1813	11, 716, 017	6, 568, 527	5, 147, 490			.100
1814	7, 758, 738	220, 599	7, 538, 139			.100
1815	19, 596, 577	7, 501, 384	12, 095, 193	.210	2, 539, 990	.100
1816	25, 976, 118	8, 948, 713	17, 027, 405			.100
1817	31, 318, 054	10, 030, 072	21, 287, 982			.050
1818	28, 993, 565	6, 095, 837	22, 897, 728			.050
1819	23, 196, 430	8, 570, 059	14, 626, 371			.050
FOURTH DECENNIUM.						
1820	[3]22, 235, 044	11, 656, 274	10, 578, 770	.210	2, 221, 541	.050
1821	21, 273, 659	9, 387, 596	11, 886, 063	.202	2, 402, 491	.050
1822	25, 785, 390	7, 267, 119	18, 518, 271	.210	3, 899, 042	.050
1823	37, 337, 732	20, 900, 687	16, 437, 045	.172	2, 835, 420	.050
1824	[4]39, 224, 251	19, 427, 227	19, 797, 024	.126	2, 513, 950	.050
1825	45, 190, 630	24, 512, 568	20, 678, 062	.096	1, 995, 892	.050
1826	[9]43, 319, 497	11, 584, 713	31, 734, 784	.085	2, 710, 536	.050
1827	50, 051, 986	21, 697, 789	28, 354, 197	.075	2, 139, 607	.050
1828	55, 194, 697	16, 037, 964	39, 156, 733	.094	3, 695, 241	.050
1829	51, 133, 538	18, 083, 843	33, 049, 695	.092	3, 052, 020	.050
FIFTH DECENNIUM.						
1830	51, 488, 248	13, 124, 561	38, 363, 687	.082	3, 180, 479	.050
1831	81, 757, 386	6, 056, 629	75, 700, 757	.076	5, 796, 139	.035
1832	91, 722, 329	55, 251, 158	36, 471, 171	.068	2, 516, 129	.015
1833	99, 955, 020	24, 897, 114	75, 057, 906	.100	7, 525, 610	.015
1834	80, 153, 366	35, 806, 861	44, 346, 505	.100	4, 473, 937	Free
1835	103, 199, 577	11, 446, 775	91, 752, 802	.102	9, 381, 689	Free
1836	93, 790, 507	16, 143, 207	77, 647, 300	.098	7, 667, 877	Free
1837	88, 140, 403	12, 096, 332	76, 044, 071	.096	7, 335, 506	Free
1838	88, 139, 720	5, 267, 087	82, 872, 633	.086	7, 138, 010	Free
1839	106, 696, 992	6, 824, 475	99, 872, 517	.090	9, 006, 685	Free

in the United States for each fiscal year from 1790 *to* 1878.

Value of coffee consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*			*Pounds.*		*Pounds.*	*Number.*	*Pounds.*
95, 484	......	......	......	3, 789.373	......	3, 789, 373	3, 929, 214	
140, 627	594, 152	......	......	3, 515, 699	......	3, 515, 699	4, 049, 247	
257, 187	......	......	......	6, 429, 699	......	6, 429, 699	4, 172, 945	
675, 125	......	......	......	16, 878, 129	......	16, 878, 129	4, 300, 425	
142, 402	......	......	......	3, 560, 058	......	3, 560, 058	4, 431, 802	1. 12
263, 684	......	......	......	5, 273, 681	......	5, 273, 681	4, 567, 292	
......	......	......	......	......	......	......	4, 706, 926	
248, 480	......	......	......	4, 969, 615	......	4, 969, 615	4, 850, 718	
306, 659	......	......	......	6, 133, 180	......	6, 133, 180	4, 998, 706	
......	......	......	......	......	......	......	5, 151, 117	
439, 623	......	......	......	8, 792, 472	......	8, 792, 472	5, 308, 483	
613, 870	......	......	......	12, 277, 410	......	12, 277, 410	5, 475, 385	
219, 043	1, 174, 071	......	......	4, 380, 863	......	4, 380, 863	5, 647, 854	
342, 190	1, 875, 201	......	......	6, 843, 800	......	6, 843, 800	5, 825, 758	
248, 265	1, 395, 252	......	......	4, 965, 316	......	4, 965, 316	6, 009, 469	2. 12
439, 051	......	......	......	8, 781, 026	......	8, 781, 026	6, 198, 858	
449, 606	......	......	......	8, 992, 126	......	8, 992, 126	6, 394, 211	
1, 735, 111	11, 451, 737	......	......	34, 702, 238	......	34, 702, 238	6, 595, 718	
1, 485, 495	......	......	......	29, 709, 905	......	29, 709, 905	6, 803, 567	
529, 965	......	......	......	10, 599, 315	......	10, 599, 315	7, 018, 007	
......	......	......	......	......	......	......	7, 239, 881	
990, 061	......	......	......	19, 801, 230	......	19, 801, 230	7, 449, 832	
909, 605	......	......	......	18, 192, 101	......	18, 192, 101	7, 665, 973	
514, 749	......	......	......	5, 147, 490	......	5, 147, 490	7, 888, 280	
753, 813	......	......	......	7, 538, 139	......	7, 538, 139	8, 117, 036	
1, 209, 519	3, 749, 509	......	......	12, 095, 193	......	12, 095, 193	8, 352, 429	1. 68
1, 704, 740	......	......	......	17, 027, 405	......	17, 027, 405	8, 595, 645	
1, 064, 399	......	......	......	21, 287, 982	......	21, 287, 982	8, 845, 887	
1, 144, 886	......	......	......	22, 897, 728	......	22, 897, 728	9, 103, 354	
731, 318	......	......	......	14, 626, 371	......	14, 626, 371	9, 365, 460	
528.938	2, 750, 479	......	......	10, 578, 770	......	10, 578, 770	9, 638, 453	
594, 303	2, 996, 794	......	......	11, 886, 063	......	11, 886, 063	9, 917, 091	
925, 913	4, 824, 955	......	......	18, 518, 271	......	18, 518, 271	10, 205, 555	
821, 852	3, 657, 272	......	......	16, 437, 045	......	16, 437, 045	10, 504, 195	
989, 851	3, 503, 801	......	......	19, 797, 024	......	19, 797, 024	10, 813, 777	2. 09
1, 033, 903	3, 029, 795	......	......	20, 678, 062	......	20, 678, 062	11, 132, 991	
1, 586, 739	4, 297, 275	......	......	31, 734, 784	......	31, 734, 784	11, 459, 903	
1, 417, 709	3, 557, 316	......	......	28, 354, 197	......	28, 354, 197	11, 803, 775	
1, 957, 836	5, 653, 077	......	......	39, 156, 733	......	39, 156, 733	12, 157, 956	
1, 652, 484	4, 704, 504	......	......	33, 049, 695	......	33, 049, 695	12, 508, 898	
1, 918, 184	5, 098, 663	......	......	38, 363, 687	......	38, 363, 687	12, 866, 020	
2, 649, 526	8, 445, 665	......	......	75, 700, 757	......	75, 700, 757	13, 205, 429	
547, 068	3, 063, 188	......	......	36, 471, 171	......	36, 471, 171	13, 615, 826	
346, 877	7, 872, 487	......	......	75, 057, 906	......	75, 057, 906	14, 019, 343	
......	4, 473, 937	......	......	44, 346, 505	......	44, 346, 505	14, 420, 731	4. 76
......	9, 381, 689	......	......	91, 752, 802	......	91, 752, 802	14, 814, 243	
......	7, 667, 877	......	......	77, 647, 300	......	77, 647, 300	15, 270, 483	
......	7, 335, 506	......	......	76, 044, 071	......	76, 044, 071	15, 711, 264	
......	7, 138, 010	......	......	82, 872, 633	......	82, 872, 633	16, 120, 891	
......	9, 006, 685	......	......	99, 872, 517	......	99, 872, 517	16, 599, 492	

TABLE II.—*Imports, exports, cost, and consumption of coffee in the*

Years.	Foreign.			Value of coffee consumed.		
	Imports.	Exports.	Difference.	Price per pound.	Value.	Rate of duty.
SIXTH DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1840	94, 996, 095	8, 698, 334	86, 297, 761	.088	7, 615, 824	Free
1841	114, 984, 783	5, 784, 536	109, 200, 247	.090	9, 855, 273	Free
1842	112, 865, 927	5, 381, 068	107, 484, 859	.078	8, 455, 312	Discriminating duties on certain imports, ten per cent. ad valorem.
1843	[5]92, 914, 557	6, 436, 994	86, 477, 563	.069	5, 972, 795	
1844	160, 561, 943	8, 620, 291	151, 941, 652	.060	9, 223, 975	
1845	108, 133, 369	13, 530, 032	94, 603, 337	.056	5, 401, 057	
1846	132, 812, 734	8, 363, 411	124, 449, 323	.062	7, 811, 975	
1847	156, 808, 122	6, 390, 283	150, 417, 839	.057	8, 660, 148	
1848	151, 432, 125	7, 048, 671	144, 383, 454	.053	7, 781, 399	
1849	165, 386, 648	14, 423, 577	150, 963, 071	.054	8, 207, 896	
SEVENTH DECENNIUM.						
1850	145, 272, 687	15, 481, 221	129, 791, 466	.076	9, 918, 472	
1851	152, 519, 743	3, 527, 238	148, 992, 505	.083	12, 489, 671	
1852	193, 906, 353	13, 193, 666	180, 712, 687	.073	13, 372, 124	
1853	199, 408, 045	13, 368, 802	186, 039, 243	.077	14, 380, 383	
1854	162, 255, 993	12, 009, 590	150, 246, 403	.089	13, 377, 972	
1855	191, 478, 657	16, 328, 217	175, 150, 440	.088	15, 486, 423	
1856	235, 865, 268	12, 226, 789	223, 638, 479	.090	20, 321, 142	
1857	240, 676, 227	24, 020, 250	216, 655, 977	.091	19, 809, 854	
1858	189, 211, 300	14, 714, 139	174, 497, 161	.096	16, 779, 870	
1859	264, 436, 534	17, 615, 586	246, 820, 948	.094	23, 262, 279	
EIGHTH DECENNIUM.						
1860	202, 144, 733	20, 095, 206	182, 049, 527	.107	19, 615, 106	
1861	184, 706, 655	6, 589, 203	178, 117, 452	.111	19, 814, 485	
1862	122, 799, 311	9, 785, 633	113, 013, 678	.113	12, 810, 125	.045
1863	80, 461, 704	5, 652, 846	74, 808, 858	.124	9, 314, 398	.050
1864	131, 622, 782	3, 778, 296	127, 844, 496	.120	15, 349, 966	.050
1865	106, 463, 062	22, 147, 017	84, 316, 045	.065	5, 525, 653	.050
1866	181, 413, 192	5, 618, 309	175, 794, 883	.111	19, 629, 927	.050
1867	187, 236, 580	5, 964, 592	181, 271, 988	.111	[6]19, 250, 604	.050
1868	248, 983, 900	7, 900, 980	241, 082, 920	.105	22, 315, 316	.050
1869	254, 160, 993	10, 765, 395	243, 395, 598	.098	22, 779, 574	.050
NINTH DECENNIUM.						
1870	235, 256, 574	4, 083, 000	231, 173, 574	.101	25, 630, 715	.050
1871	317, 992, 048	5, 257, 012	312, 735, 036	.099	29, 428, 698	.0372
1872	298, 805, 946	3, 467, 462	295, 338, 484	.109	26, 140, 340	.030
1873	293, 297, 271	6, 851, 027	286, 446, 244	.144	58, 722, 043	([7])
1874	285, 171, 512	3, 285, 636	281, 885, 876	.192	55, 034, 302	....
1875	317, 970, 665	6, 834, 014	311, 136, 651	.159	50, 448, 852	....
1876	339, 789, 246	8, 884, 457	330, 904, 789	.167	56, 825, 513	....
1877	331, 639, 723	9, 890, 715	321, 749, 008	.161	53, 634, 199	....
1878	....	....	....	....	....	....

[1] These imports are for calendar years and not fiscal years.
[2] Error of 300,000 pounds in addition in American State Papers, Vol. I, Commerce and Navigation, page 576.
[3] Estimated by taking the mean between imports of 1819 and 1821, there being no statistics on record for this year.
[4] Error of 9,000,000 pounds in addition in Report of Commerce and Navigation for 1824, pages 28 and 29.
[5] These imports are for nine months, from October 1, 1842, to June 30, 1843.
[6] After 1867, inclusive, the amount of coffee consumed, with the value of and duty paid on the same, is taken from the Annual Reports on Commerce and Navigation. Previous to that date the difference between the imports and exports is considered the consumption, and the duty and value are calculated on that amount.

United States for each fiscal year from 1790 *to* 1878—Continued.

Value of coffee consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*			*Pounds.*		*Pounds.*	*Number.*	*Pounds.*
....	7, 615, 824	....	....	86, 297, 761	....	86, 297, 761	17, 070, 240	
....	9, 855, 273	....	....	109, 200, 247	....	109, 200, 247	17, 563, 990	
746	8, 456, 058	....	....	107, 484, 859	....	107, 484, 859	18, 065, 813	
4, 887	5, 977, 682	....	....	86, 477, 563	....	86, 477, 563	18, 603, 956	
16, 968	9, 240, 943	....	....	151, 941, 652	....	151, 941, 652	19, 102, 946	6. 18
2, 053	5, 403, 110	....	....	94, 603, 337	....	94, 603, 337	19, 640, 029	
908	7, 812, 883	....	....	124, 449, 323	....	124, 449, 323	20, 225, 760	
668	8, 660, 816	....	....	150, 417, 839	....	150, 417, 839	20, 869, 760	
4, 670	7, 786, 069	....	....	144, 383, 454	....	144, 383, 454	21, 609, 554	
....	8, 207, 896	....	....	150, 963, 071	....	150, 963, 071	22, 358, 293	
294	9, 918, 766	....	....	129, 791, 466	....	129, 791, 466	23, 191, 876	
379	12, 490, 050	....	....	148, 992, 505	....	148, 992, 505	23, 974, 993	
1, 371	13, 373, 495	....	....	180, 712, 687	....	180, 712, 687	24, 843, 547	
1, 830	14, 382, 213	....	....	186, 039, 243	....	186, 039, 243	25, 721, 956	
1, 239	13, 379, 211	....	....	150, 246, 403	....	150, 246, 403	26, 615, 328	6. 78
6, 618	15, 493, 041	....	....	175, 150, 440	....	175, 150, 440	27, 586, 113	
5, 936	20, 327, 078	....	....	223, 638, 479	....	223, 638, 479	28, 349, 746	
3, 282	19, 813, 136	....	....	216, 655, 977	....	216, 655, 977	29, 124, 515	
2, 825	16, 782, 695	....	....	174, 497, 161	....	174, 497, 161	29, 966, 042	
1, 716	23, 263, 995	....	....	246, 820, 948	....	246, 820, 948	30, 685, 586	
11, 151	19, 626, 257	....	....	182, 049, 527	....	182, 049, 527	31, 443, 321	
607	19, 815, 092	....	....	178, 117, 452	....	178, 117, 452	32, 238, 403	
3, 193, 110	16, 003, 235	....	....	113, 013, 678	....	113, 013, 678	32, 987, 985	
3, 740, 443	13, 054, 841	....	....	74, 808, 858	....	74, 808, 858	33, 211, 430	
6, 302, 224	21, 742, 190	....	....	127, 844, 496	....	127, 844, 496	33, 345, 224	4. 56
4, 215, 802	9, 741, 455	....	....	84, 316, 045	....	84, 316, 045	33, 394, 882	
8, 789, 744	28, 419, 671	....	....	175, 794, 883	....	175, 794, 883	34, 324, 665	
[6]8, 637, 089	27, 887, 693	....	....	[6]172, 741, 783	....	[6]172, 741, 783	35, 342, 849	
10, 637, 845	32, 953, 161	....	....	212, 379, 267	....	212, 379, 267	36, 361, 669	
11, 540, 719	34, 320, 293	....	....	230, 814, 377	....	230, 814, 377	37, 400, 130	
12, 678, 583	38, 309, 298	....	....	253, 571, 665	....	253, 571, 665	38, 558, 371	
10, 969, 099	40, 397, 797	....	....	294, 930, 950	....	294, 930, 950	39, 723, 755	
7, 192, 075	33, 332, 415	....	....	239, 735, 831	....	239, 735, 831	40, 967, 095	
24, 462	58, 746, 505	....	....	401, 975, 241	....	401, 975, 241	42, 265, 762	
29, 172	55, 063, 474	....	....	285, 569, 219	....	285, 569, 219	43, 456, 931	7. 20
9, 659	50, 458, 511	....	....	317, 017, 310	....	317, 017, 310	44, 588, 083	
6, 802	56, 832, 315	....	....	338, 548, 996	....	338, 548, 996	45, 687, 668	
1, 526	53, 635, 725	....	....	332, 005, 637	....	332, 005, 637	46, 761, 551	
....	....	....	....	....	....	....	47, 874, 485	

[7] According to act of Congress, May 1, 1872, coffee was made exempt from duty. By act of June 6, 1872, a discriminating duty of 10 per cent. ad valorem was laid on coffee, according to its place of importation.

[8] Previous to 1820 the price per pound of the imports is taken and not the average price per pound of the difference. The years 1807 and 1815 are quoted from "Pitkin's Commerce of the United States."

[9] Error of 6,000,000 pounds in addition in the Report of Commerce and Navigation for 1826.

TABLE III.—*Imports, exports, cost, production, and consumption of brown*

Years.	Foreign.			Value of foreign brown sugar consumed.		
	Imports.	Exports.	Difference.	Price per pound.	Value.	Rate of duty.
FIRST DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1790	17, 856, 395	33, 358	17, 823, 037	....	(7)	. 010
1791	24, 356, 594	73, 304	24, 283, 290	....	....	. 015
1792	(1)24, 091, 155	1, 122, 156	22, 968, 999	....	....	. 015
1793	(1)43, 546, 072	4, 539, 809	39, 006, 263	....	....	. 015
1794	(1)43, 627, 926	20, 721, 761	22, 906, 165	....	....	. 015
1795	60, 780, 502	21, 377, 747	39, 402, 755	....	....	. 015
1796	58, 567, 883	34, 848, 644	23, 719, 239	....	....	. 015
1797	63, 689, 806	38, 366, 262	25, 323, 544	....	....	. 015
1798	66, 889, 514	51, 703, 963	15, 185, 551	....	....	. 020
1799	69, 974, 972	78, 821, 571	− 8, 846, 599	....	....	. 020
SECOND DECENNIUM.						
1800	81, 749, 476	56, 432, 516	25, 316, 960	....	....	. 020
1801	96, 929, 621	97, 565, 732	− 636, 111	....	....	. 025
1802	84, 140, 950	61, 061, 820	23, 079, 130	....	....	. 025
1803	69, 184, 539	19, 781, 455	49, 403, 084	....	....	. 025
1804	117, 034, 237	54, 085, 650	62, 948, 587	....	....	. 025
1805	155, 061, 407	95, 618, 316	59, 443, 091	....	....	. 025
1806	162, 102, 040	106, 249, 397	55, 852, 643	....	....	. 025
1807	175, 110, 619	105, 721, 881	69, 388, 738	(6). 100	6, 938, 874	. 025
1808	81, 009, 128	20, 835, 575	60, 173, 553	....	....	. 025
1809	57, 662, 461	27, 577, 391	30, 085, 070	....	....	. 025
THIRD DECENNIUM.						
1810	44, 953, 565	28, 535, 494	16, 418, 071	....	....	. 025
1811	58, 317, 955	5, 189, 885	53, 128, 070	....	....	. 025
1812	67, 051, 620	3, 233, 315	63, 818, 305	....	....	. 025
1813	27, 729, 676	3, 479, 326	24, 250, 350	....	....	. 050
1814	26, 457, 943	362	26, 457, 581	....	....	. 050
1815	41, 331, 226	2, 528, 324	38, 802, 902	(6). 160	6, 208, 464	. 050
1816	48, 566, 635	15, 359, 061	33, 207, 574	....	....	. 050
1817	84, 628, 188	15, 876, 268	68, 751, 920	....	....	. 030
1818	61, 850, 649	18, 162, 025	43, 688, 624	....	....	. 030
1819	69, 795, 224	9, 780, 858	60, 014, 356	....	....	. 030
FOURTH DECENNIUM.						
1820	(2)61, 470, 439	27, 804, 318	33, 666, 121	....	....	. 030
1821	53, 145, 654	15, 548, 582	37, 597, 072	....	....	. 030
1822	77, 470, 813	8, 853, 575	68, 617, 238	....	....	. 030
1823	53, 788, 724	15, 435, 173	38, 353, 551	....	....	. 030
1824	80, 133, 429	8, 348, 469	71, 784, 960	....	....	. 030
1825	64, 480, 041	15, 435, 561	49, 044, 480	. 052	2, 594, 834	. 030
1826	76, 050, 015	17, 010, 220	59, 039, 795	. 055	3, 256, 553	. 030
1827	70, 108, 937	12, 015, 230	58, 093, 707	. 054	3, 181, 340	. 030
1828	51, 686, 955	8, 999, 992	42, 686, 963	. 057	2, 438, 742	. 030
1829	58, 597, 574	10, 643, 859	47, 953, 715	. 053	2, 570, 730	. 030
FIFTH DECENNIUM.						
1830	78, 576, 388	6, 676, 265	71, 900, 123	. 049	3, 573, 510	. 030
1831	98, 576, 928	17, 297, 837	81, 279, 091	. 041	3, 334, 429	. 030
1832	60, 117, 717	14, 230, 070	45, 887, 647	. 040	1, 840, 498	. 030
1833	85, 689, 044	2, 001, 424	83, 687, 620	. 046	3, 867, 657	. 025
1834	(3)107, 483, 891	(3)11, 035, 926	96, 447, 965	. 045	4, 405, 243	. 025
1835	111, 806, 880	3, 786, 017	108, 020, 863	. 050	5, 496, 900	. 025
1836	181, 244, 505	30, 429, 836	150, 814, 669	. 060	9, 198, 300	. 025
1837	120, 416, 071	27, 875, 456	92, 540, 615	. 048	4, 454, 593	. 025
1838	139, 201, 069	4, 503, 074	134, 697, 995	. 045	6, 189, 007	. 025
1839	182, 540, 327	6, 191, 263	176, 349, 064	. 048	8, 522, 375	. 025

sugar in the United States for each fiscal year from 1790 *to* 1878.

Value of foreign brown sugar consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Lbs.*
178, 230	...	...	...	17, 823, 037	...	17, 823, 037	3, 929, 214	
364, 249	...	...	...	24, 283, 290	...	24, 283, 290	4, 049, 247	
344, 535	...	175, 000	...	22, 968, 999	175, 000	23, 143, 999	4, 172, 945	
585, 094	...	188, 125	...	39, 006, 263	188, 125	39, 194, 388	4, 300, 425	
343, 592	...	210, 000	...	22, 906, 165	210, 000	23, 116, 165	4, 431, 802	
591, 041	...	253, 750	...	39, 402, 755	253, 750	39, 656, 505	4, 567, 292	4. 96
355, 789	...	297, 500	...	23, 719, 239	297, 500	24, 016, 739	4, 706, 926	
379, 853	...	350, 000	...	25, 323, 544	350, 000	25, 673, 544	4, 850, 718	
126, 779	...	437, 000	...	6, 338, 952	437, 000	6, 775, 952	4, 998, 706	
...	...	525, 000	...	...	525, 000	525, 000	5, 151, 117	
493, 617	...	875, 000	...	24, 680, 849	875, 000	25, 555, 849	5, 308, 483	
...	...	2, 625, 000	...	...	2, 625, 000	2, 625, 000	5, 475, 385	
576, 978	...	4, 375, 000	...	23, 079, 130	4, 375, 000	27, 454, 130	5, 647, 854	
1, 235, 077	...	5, 425, 000	3, 420	49, 403, 084	5, 421, 580	54, 824, 664	5, 825, 758	
1, 573, 714	...	6, 562, 000	818, 014	62, 948, 587	5, 743, 986	68, 692, 573	6, 009, 469	
1, 486, 077	...	7, 262, 000	251, 827	59, 443, 091	7, 010, 173	66, 453, 264	6, 198, 858	8. 20
1, 396, 316	...	7, 875, 000	209, 286	55, 852, 643	7, 665, 714	63, 518, 357	6, 394, 211	
1, 734, 718	8, 673, 592	8, 750, 000	17, 400	69, 388, 738	8, 732, 600	78, 121, 338	6, 595, 718	
1, 504, 339	...	12, 250, 000	12, 420	60, 173, 553	12, 237, 580	72, 411, 133	6, 803, 567	
752, 126	...	13, 125, 000	21, 375	30, 085, 070	13, 103, 625	43, 188, 695	7, 018, 007	
410, 452	...	14, 000, 000	14, 123	16, 418, 071	13, 985, 877	30, 403, 948	7, 239, 881	
1, 328, 202	...	15, 750, 000	173, 012	53, 128, 070	15, 576, 988	68, 705, 058	7, 449, 832	
1, 595, 458	...	16, 875, 000	131, 921	63, 818, 305	16, 743, 079	80, 561, 384	7, 665, 973	
1, 212, 518	...	17, 500, 000	729, 750	24, 250, 350	16, 770, 250	41, 020, 600	7, 888, 280	
1, 322, 879	...	18, 375, 000	756	26, 457, 581	18, 374, 244	44, 831, 825	8, 117, 036	
1, 940, 145	8, 148, 609	19, 250, 000	6, 260	38, 802, 902	19, 243, 740	58, 046, 642	8, 352, 429	7. 42
1, 660, 379	...	20, 125, 000	17, 750	33, 207, 574	20, 107, 250	53, 314, 824	8, 595, 645	
2, 061, 558	...	21, 000, 000	36, 454	68, 751, 920	20, 963, 546	89, 715, 466	8, 845, 887	
1, 310, 659	...	21, 437, 500	52, 901	43, 688, 624	21, 384, 599	65, 073, 223	9, 103, 354	
1, 800, 431	...	21, 875, 000	32, 267	60, 014, 356	21, 842, 733	81, 857, 089	9, 365, 460	
1, 009, 984	...	23, 625, 000	62, 792	33, 666, 121	23, 562, 208	57, 228, 329	9, 638, 453	
1, 127, 912	...	25, 375, 000	24, 592	37, 597, 072	25, 350, 408	62, 947, 480	9, 917, 091	
2, 058, 517	...	26, 250, 000	8, 593	68, 617, 238	26, 241, 407	94, 858, 645	10, 205, 555	
1, 150, 607	...	30, 318, 750	3, 846	38, 353, 551	30, 314, 904	68, 668, 455	10, 504, 195	
2, 153, 549	...	32, 340, 000	5, 960	71, 784, 960	32, 334, 040	104, 119, 000	10, 813, 777	
1, 471, 334	4, 066, 168	30, 318, 750	27, 782	49, 044, 480	30, 290, 968	79, 335, 448	11, 132, 991	8. 44
1, 771, 194	5, 027, 747	45, 478, 125	57, 025	59, 039, 795	45, 421, 100	104, 460, 895	11, 459, 903	
1, 742, 811	4, 924, 151	71, 754, 375	18, 703	58, 093, 707	71, 735, 672	129, 829, 379	11, 803, 775	
1, 280, 609	3, 719, 351	88, 899, 628	54, 035	42, 686, 963	88, 845, 593	131, 532, 556	12, 157, 956	
1, 438, 611	4, 009, 341	48, 750, 529	53, 778	47, 953, 715	48, 696, 751	96, 650, 466	12, 508, 898	
2, 157, 094	5, 730, 514	73, 775, 625	37, 646	71, 900, 123	73, 737, 979	145, 638, 102	12, 866, 020	
2, 438, 373	5, 772, 802	75, 796, 875	180, 132	81, 279, 091	75, 616, 743	156, 895, 834	13, 205, 429	
1, 376, 629	3, 217, 127	75, 796, 875	154, 160	45, 887, 647	75, 642, 715	121, 530, 362	13, 615, 826	
2, 092, 191	5, 959, 848	70, 743, 750	100, 340	83, 687, 620	70, 643, 410	154, 331, 030	14, 019, 343	
2, 411, 199	6, 816, 442	75, 796 875	108, 087	96, 447, 965	75, 688, 788	172, 136, 753	14, 420, 731	
2, 700, 522	8, 197, 422	101, 062, 500	102, 431	108, 020, 863	100, 960, 069	208, 980, 932	14, 814, 243	11. 93
3, 770, 367	12, 968, 667	30, 318, 750	128, 119	150, 814, 669	30, 190, 631	181, 005, 300	15, 270, 483	
2, 313, 515	6, 768, 108	70, 743, 750	306, 602	92, 540, 615	70, 437, 148	162, 977, 763	15, 711, 264	
3, 367, 450	9, 556, 457	65, 690, 625	408, 802	134, 697, 995	65, 281, 823	199, 979, 818	16, 120, 891	
4, 408, 727	12, 931, 102	70, 743, 750	387, 203	176, 349, 064	70, 356, 547	246, 705, 611	16, 599 492	

TABLE III.—*Imports, exports, cost, production, and consumption of brown sugar*

Years.	Foreign.			Value of foreign brown sugar consumed.		
	Imports.	Exports.	Difference.	Price per pound.	Value.	Rate of duty.
SIXTH DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1840	107, 955, 033	9, 790, 704	98, 164, 329	.042	4, 189, 964	.025
1841	165, 963, 083	2, 055, 567	163, 907, 516	.045	7, 484, 860	.025
1842	155, 414, 946	5, 316, 114	150, 098, 832	.034	5, 191, 060	.025
1843	(4)69, 534, 331	1, 536, 476	67, 997, 855	.034	2, 356, 294	.025
1844	179, 857, 491	1, 547, 965	178, 309, 526	.037	6, 705, 852	.025
1845	111, 957, 404	11, 199, 089	100, 758, 315	.039	4, 015, 289	.025
1846	126, 731, 661	19, 347, 414	107, 384, 247	.040	4, 341, 292	.025
1847	226, 683, 261	5, 756, 260	220, 927, 001	.040	9, 052, 941	30 pr. ct.
1848	248, 201, 117	11, 614, 129	236, 586, 988	.035	8, 367, 189	30 pr. ct.
1849	253, 815, 485	14, 857, 046	238, 958, 439	.029	7, 157, 121	30 pr. ct.
SEVENTH DECENNIUM.						
1850	197, 651, 819	12, 186, 113	185, 465, 706	.033	6, 183, 538	30 pr. ct.
1851	363, 537, 861	3, 795, 625	359, 742, 236	.035	12, 694, 623	30 pr. ct.
1852	450, 312, 593	8, 060, 309	442, 252, 284	.031	13, 733, 554	30 pr. ct.
1853	456, 510, 627	18, 073, 933	438, 436, 694	.031	13, 880, 426	30 pr. ct.
1854	449, 520, 309	49, 820, 419	399, 699, 890	.028	11, 464, 666	30 pr. ct
1855	468, 307, 442	29, 660, 189	438, 647, 253	.030	13, 314, 713	30 pr. ct.
1856	542, 813, 245	20, 929, 675	521, 883, 570	.040	21, 369, 736	30 pr. ct
1857	774, 931, 815	12, 168, 659	762, 763, 156	.054	41, 730, 011	30 pr. ct
1858	517, 228, 624	71, 674, 178	445, 554, 446	.042	19, 082, 260	24 pr. ct.
1859	654, 226, 145	29, 404, 847	624, 821, 298	.045	28, 669, 343	24 pr. ct.
EIGHTH DECENNIUM.						
1860	692, 944, 872	28, 988, 404	663, 956, 468	.044	29, 288, 548	24 pr. ct.
1861	807, 133, 607	73, 819, 676	733, 313, 931	.037	27, 245, 863	24 pr. ct.
1862	528, 285, 883	18, 718, 279	509, 567, 604	.035	18, 195, 538	.02
1863	452, 899, 397	7, 266, 128	445, 633, 269	.035	15, 864, 496	.02
1864	573, 726, 795	21, 340, 617	552, 386, 178	.044	24, 813, 830	.02
1865	542, 181, 945	28, 540, 457	513, 641, 488	.037	19, 569, 541	.03
1866	834, 246, 724	3, 108, 981	831, 137, 743	.039	32, 726, 388	.03
1867	776, 790, 365	6, 980, 327	769, 810, 038	.040	(5)34, 896, 938	.03
1868	1, 028, 153, 650	14, 511, 537	1, 013, 642, 113	.042	39, 422, 165	.03
1869	1, 229, 329, 259	16, 888, 217	1, 212, 441, 042	.046	43, 647, 276	.03
NINTH DECENNIUM.						
1870	1, 160, 460, 114	16, 242, 129	1, 144, 217, 985	.048	53, 575, 314	.03
1871	1, 189, 155, 938	6, 733, 692	1, 182, 422, 246	.048	51, 943, 566	.03
1872	1, 457, 294, 818	11, 826, 955	1, 445, 467, 863	.053	67, 860, 919	.03
1873	1, 454, 124, 259	21, 273, 487	1, 432, 850, 772	.053	70, 708, 834	.03
1874	1, 594, 306, 354	13, 125, 410	1, 581, 180, 944	.050	74, 310, 573	.03
1875	1, 695, 726, 353	10, 330, 322	1, 685, 396, 031	.043	67, 930, 620	.03
1876	1, 414, 254, 663	12, 599, 772	1, 401, 654, 891	.040	63, 481, 834	.025
1877	1, 584, 162, 924	3, 077, 622	1, 581, 085, 302	.049	71, 621, 374	.025
1878	....	....	....	....	....	....

[1] These imports are for calendar years and not fiscal years.
[2] Estimated by taking the mean between the imports of 1819 and 1821, there being no statistics on record for this year.
[3] From 1834 to 1839, inclusive, a small quantity of melado is included in the imports and exports.
[4] These imports are from October 1, 1842, to June 30, 1843, nine months.
[5] From 1867, inclusive, the consumption of foreign sugar, with its value and duty, is taken from the Annual Reports on Commerce and Navigation; previous to that date it is obtained by subtracting the exports from the imports, and the value and duty are calculated on this difference.

in the United States for each fiscal year from 1790 *to* 1878—Continued.

Value of foreign brown sugar consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Lbs.*
2, 454, 108	6, 644, 072	116, 221, 875	769, 908	98, 164, 329	115, 451, 967	213, 616, 296	17, 070, 240	
4, 097, 688	11, 582, 548	88, 761, 750	312, 864	163, 907, 516	88, 448, 886	252, 356, 402	17, 563, 990	
3, 752, 471	8, 943, 531	91, 822, 500	166, 533	150, 098, 832	91, 655, 967	241, 754, 799	18, 065, 813	
1, 699, 946	4, 056, 240	142, 835, 000	68, 563	67, 997, 855	142, 766, 437	210, 764, 292	18, 603, 956	
4, 457, 738	11, 163, 590	102, 378, 006	187, 118	178, 309, 526	102, 190, 888	280, 500, 414	19, 102, 946	
2, 518, 958	6, 534, 247	204, 050, 000	195, 985	100, 758, 315	203, 854, 015	304, 612, 330	19, 640, 029	15. 94
2, 684, 606	7, 025, 898	189, 766, 500	109, 295	107, 384, 247	189, 657, 205	297, 041, 452	20, 225, 760	
3, 073, 333	12, 126, 274	142, 835, 000	388, 057	220, 927, 001	142, 446, 943	363, 373, 944	20, 869, 760	
2, 510, 157	10, 877, 346	244, 860, 000	135, 006	236, 586, 988	244, 724, 994	481, 311, 982	21, 609, 554	
2, 147, 136	9, 304, 257	226, 800, 000	399, 209	238, 958, 439	226, 400, 791	465, 359, 230	22, 358, 293	
1, 855, 061	8, 038, 599	257, 715, 958	458, 839	185, 465, 706	257, 257, 119	442, 722, 825	23, 191, 876	
3, 808, 387	16, 503, 010	219, 543, 439	561, 828	359, 742, 236	218, 981, 611	578, 723, 847	23, 974, 993	
4, 120, 066	17, 853, 620	245, 890, 606	401, 620	442, 252, 284	245, 488, 986	687, 741, 270	24, 843, 547	
4, 164, 128	18, 044, 554	334, 650, 393	672, 274	438, 436, 694	333, 978, 119	772, 414, 813	25, 721, 956	
3, 439, 400	14, 904, 066	458, 422, 811	5, 104, 340	399, 699, 890	453, 318, 471	853, 018, 361	26, 615, 328	
3, 994, 414	17, 309, 127	353, 654, 359	4, 062, 625	438, 647, 253	349, 591, 734	788, 238, 987	27, 586, 113	27. 55
6, 410, 921	27, 780, 657	236, 113, 397	5, 170, 819	521, 883, 570	230, 942, 578	752, 826, 148	28, 349, 746	
12, 519, 003	54, 249, 014	76, 479, 795	2, 196, 412	762, 763, 156	74, 283, 383	837, 046, 539	29, 124, 515	
4, 579, 742	23, 662, 002	291, 846, 938	5, 410, 225	445, 554, 446	286, 436, 713	731, 991, 159	29, 966, 042	
6, 880, 642	35, 549, 985	374, 466, 881	2, 582, 718	624, 821, 298	371, 884, 163	996, 705, 461	30, 685, 586	
7, 029, 252	36, 317, 800	229, 292, 437	1, 133, 986	663, 956, 468	228, 158, 451	892, 114, 919	31, 443, 321	
10, 008, 075	37, 253, 938	236, 437, 648	3, 275, 024	733, 313, 931	233, 162, 624	966, 476, 555	32, 238, 403	
10, 191, 352	28, 386, 890	482, 862, 880	1, 284, 849	509, 567, 604	481, 578, 031	991, 145, 635	32, 987, 985	
8, 912, 665	24, 777, 161	210, 210, 000	380, 348	445, 633, 269	209, 829, 652	655, 462, 921	33, 211, 430	
11, 047, 724	35, 861, 554	76, 877, 801	525, 151	552, 386, 178	76, 352, 650	628, 738, 828	33, 345, 224	
15, 409, 245	34, 978, 786	10, 397, 387	246, 445	513, 641, 488	10, 150, 942	523, 792, 430	33, 394, 882	24. 71
24, 934, 132	57, 660, 520	18, 088, 070	469, 661	831, 137, 743	17, 618, 409	848, 756, 152	34, 324, 665	
([5])26,052, 470	60, 949, 408	41, 041, 000	294, 907	[6]868, 415, 665	40, 746, 093	909, 161, 758	35, 342, 849	
27, 814, 183	67, 236, 348	37, 684, 647	3, 943	927, 123, 351	37, 680, 704	964, 804, 055	36, 361, 669	
28, 164, 953	71, 812, 229	85, 546, 102	16, 357	938, 831, 762	85, 529, 745	1, 024, 361, 507	37, 400, 130	
32, 834, 510	86, 409, 824	91, 372, 394	12, 476	1, 094, 483, 662	91, 359, 918	1, 185, 843, 580	38, 558, 371	
26, 371, 397	78, 314, 963	155, 157, 206	43, 809	1, 060, 834, 984	155, 113, 406	1, 215, 948, 390	39, 723, 755	
25, 472, 419	93, 333, 338	132, 215, 512	17, 065	1, 261, 254, 681	132, 198, 447	1, 393, 453, 128	40, 967, 095	
26, 363, 338	97, 072, 172	112, 811, 843	212, 625	1, 311, 885, 205	112, 599, 218	1, 424, 484, 423	42, 265, 762	
29, 663, 539	103, 974, 112	92, 917, 006	163, 090	1, 481, 743, 671	92, 753, 916	1, 574, 497, 587	43, 456, 931	34. 40
32, 656, 793	100, 587, 413	117, 691, 604	362, 552	1, 550, 955, 486	117, 329, 052	1, 668, 284, 538	44, 588, 083	
37, 376, 114	100, 857, 948	137, 271, 178	22, 714	1, 554, 716, 379	137, 248, 464	1, 691, 964, 843	45, 687, 668	
34, 176, 020	105, 797, 394	160, 164, 958	85, 838	1, 450, 726, 342	160, 079, 120	1, 610, 805, 462	46, 761, 551	
....	....	....	....	....	....	....	47, 874, 485	

[6] For the years 1807 and 1815 the price per pound of the *imports* is taken, and not the average price per pound of the *difference;* the figures are quoted from "Pitkin's Commerce of the United States."

[7] The only values of brown sugar on record from 1790 to 1825 are for the years 1807 and 1815, which are found in "Pitkin's Commerce of the United States."

TABLE IV.—*Imports, exports, cost, production, and consumption of*

Years.	Foreign.			Value of foreign refined sugar consumed.		
	Imports.	Exports.	Difference.	Average price per pound.	Value.	Rate of duty.
FIRST DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1790	373, 024	16, 429	356, 595			(9)
1791	545, 045	2, 357	542, 688			(9)
1792	[1]329, 217	75, 760	253, 457			(9)
1793	[1]4, 216, 433	[2]72, 179	4, 144, 254			(9)
1794	[1]5, 077, 974	[2]40, 460	5, 037, 514			(9)
1795	3, 002, 903	739, 520	2, 263, 383			(9)
1796	901, 271	984, 146	−82, 875			(9)
1797	9, 076, 015	203, 789	8, 872, 226			(9)
1798	20, 634, 404	36, 754	20, 597, 650			(9)
1799	33, 871, 496	232, 469	33, 639, 027			(9)
SECOND DECENNIUM.						
1800	31, 590, 275	124, 939	31, 465, 336			(9)
1801	39, 699, 315	168, 479	39, 530, 836			(9)
1802	14, 489, 825	118, 468	14, 371, 357			(9)
1803	4, 637, 664	3, 444, 998	1, 192, 666			(9)
1804	11, 688, 432	20, 086, 570	−8, 398, 138			(9)
1805	31, 410, 366	27, 190, 677	4, 219, 689			(9)
1806	37, 031, 397	39, 381, 444	−2, 350, 047			(9)
1807	45, 558, 480	37, 397, 724	8, 160, 756	[5].130	1, 060, 898	(9)
1808	23, 402, 649	8, 126, 952	15, 275, 697			(9)
1809	19, 090, 933	17, 719, 947	1, 370, 986			(9)
THIRD DECENNIUM.						
1810	10, 151, 157	18, 488, 508	−8, 337, 351			(9)
1811	18, 882, 639	13, 078, 462	5, 804, 177			(9)
1812	16, 358, 336	10, 693, 962	5, 664, 374			(9)
1813	5, 667, 362	3, 137, 962	2, 529, 400			(9)
1814	3, 007, 000	400	3, 006, 600			(9)
1815	3, 711, 936	660, 394	3, 051, 542	[5].231	704, 906	(9)
1816	6, 543, 746	2, 364, 906	4, 178, 840			(9)
1817	8, 419, 180	4, 318, 900	4, 100, 280			(9)
1818	6, 508, 287	3, 895, 879	2, 612, 408			(9)
1819	4, 149, 433	1, 486, 314	2, 663, 119			(9)
FOURTH DECENNIUM.						
1820	[3]5, 259, 740	3, 584, 791	1, 674, 949			(9)
1821	6, 370, 047	4, 513, 143	1, 856, 904			(9)
1822	10, 839, 873	5, 593, 285	5, 246, 588			(9)
1823	7, 002, 746	6, 023, 851	978, 895			(9)
1824	14, 318, 628	5, 779, 960	8, 538, 668			(9)
1825	7, 292, 427	6, 401, 210	891, 217	.025	23, 131	(9)
1826	8, 885, 944	4, 136, 636	4, 749, 308	.065	313, 367	(9)
1827	6, 593, 343	3, 328, 300	3, 265, 043	.062	204, 618	(9)
1828	5, 249, 463	1, 691, 096	3, 558, 367	.078	279, 554	(9)
1829	4, 711, 047	1, 699, 619	3, 011, 428	.078	236, 869	(9)
FIFTH DECENNIUM.						
1830	7, 913, 725	3, 049, 077	4, 864, 648	.076	373, 037	(9)
1831	10, 654, 240	5, 283, 110	5, 371, 130	.056	305, 059	(9)
1832	6, 371, 174	3, 305, 958	3, 065, 216	.052	160, 805	(9)
1833	12, 045, 394	4, 617, 730	7, 427, 664	.062	461, 817	(9)
1834	7, 908, 205	2, 933, 277	4, 974, 928	.059	298, 069	(9)
1835	14, 231, 453	3, 471, 459	10, 759, 994	.069	746, 450	(9)
1836	[4]10, 183, 800	4, 062, 446	6, 121, 354	.079	483, 640	(9)
1837	15, 733, 690	13, 249, 363	2, 484, 327	.036	91, 535	(9)
1838	14, 682, 794	7, 121, 250	7, 561, 544	.067	508, 640	(9)
1839	12, 748, 697	6, 963, 390	5, 785, 307	.072	416, 625	(9)

refined sugar in the United States for each fiscal year, from 1790 *to* 1878.

Value of foreign refined sugar consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Lbs.*
7, 419	...	...	...	356, 595	...	356, 595	3, 929, 214	
18, 985	...	...	...	542, 688	...	542, 688	4, 049, 247	
11, 434	...	25, 000	...	253, 457	25, 000	278, 457	4, 172, 945	
103, 718	...	26, 875	...	4, 144, 254	26, 875	4, 171, 129	4, 300, 425	
126, 255	...	30, 000	...	5, 037, 514	30, 000	5, 067, 514	4, 431, 802	
60, 060	...	36, 250	...	2, 180, 508	36, 250	2, 216, 758	4, 567, 292	1. 68
...	...	42, 500	...	...	42, 500	42, 500	4, 706, 926	
209, 714	...	50, 000	...	8, 872, 226	50, 000	8, 922, 226	4, 850, 718	
514, 468	...	62, 500	...	20, 597, 650	62, 500	20, 660, 150	4, 998, 706	
3, 026, 964	...	75, 000	...	33, 639, 027	75, 000	33, 714, 027	5, 151, 117	
779, 216	...	125, 000	...	31, 465, 336	125, 000	31, 590, 336	5, 308, 483	
978, 401	...	375, 000	...	39, 530, 836	375, 000	39, 905, 836	5, 475, 385	
112, 468	...	625, 000	...	7, 165, 885	625, 000	7, 790, 885	5, 647, 854	
...	...	775, 000	93, 609	...	681, 391	681, 391	5, 825, 758	
...	...	937, 500	106, 167	...	831, 333	831, 333	6, 009, 469	
57, 946	...	1, 037, 500	138, 618	1, 869, 642	898, 882	2, 768, 524	6, 198, 858	1. 72
...	...	1, 125, 000	301, 292	...	823, 708	823, 708	6, 394, 211	
258, 421	1, 319, 319	1, 250, 000	122, 586	8, 160, 756	1, 127, 414	9, 288, 170	6, 595, 718	
258, 669	...	1, 750, 000	7, 942	8, 309, 332	1, 742, 058	10, 051, 390	6, 803, 567	
...	...	1, 875, 000	266, 546	...	1, 608, 454	1, 608, 454	7, 018, 007	
...	...	2, 000, 000	748, 198	...	1, 251, 802	1, 251, 802	7, 239, 881	
174, 263	...	2, 250, 000	71, 230	5, 804, 177	2, 178, 770	7, 982, 947	7, 449, 832	
169, 945	...	2, 125, 000	10, 769	5, 664, 374	2, 114, 231	7, 778, 605	7, 665, 973	
152, 009	...	2, 500, 000	2, 570	2, 529, 400	2, 497, 430	5, 026, 830	7, 888, 280	
180, 400	...	2, 625, 000	...	3, 006, 600	2, 625, 000	5, 631, 600	8, 117, 036	
190, 634	895, 540	2, 750, 000	10, 432	3, 051, 542	2, 739, 568	5, 791, 110	8, 352, 429	. 72
251, 482	...	2, 875, 000	61, 827	4, 178, 840	2, 813, 173	6, 992, 013	8, 595, 645	
164, 386	...	3, 000, 000	144, 409	4, 100, 280	2, 855, 591	6, 955, 871	8, 845, 887	
104, 906	...	3, 062, 500	58, 993	2, 612, 408	3, 003, 507	5, 615, 915	9, 103, 354	
110, 819	...	3, 125, 000	47, 788	2, 663, 119	3, 077, 212	5, 740, 331	9, 365, 460	
66, 998	...	3, 375, 000	18, 044	1, 674, 949	3, 356, 956	5, 031, 905	9, 638, 453	
74, 448	...	3, 625, 000	156, 527	1, 856, 904	3, 468, 473	5, 325, 377	9, 917, 091	
210, 265	...	3, 750, 000	177, 065	5, 246, 588	3, 572, 935	8, 819, 523	10, 205, 555	
39, 300	...	4, 331, 250	55, 187	978, 895	4, 276, 063	5, 254, 958	10, 504, 195	
346, 578	...	4, 620, 000	57, 908	8, 538, 668	4, 562, 092	13, 100, 760	10, 813, 777	
35, 709	58, 840	4, 331, 250	50, 017	891, 217	4, 281, 233	5, 172, 450	11, 132, 991	. 84
190, 133	503, 500	6, 496, 875	168, 991	4, 749, 308	6, 327, 884	11, 077, 192	11, 459, 903	
130, 132	334, 750	10, 250, 625	236, 744	3, 265, 043	10, 013, 881	13, 278, 924	11, 803, 775	
141, 575	421, 129	12, 699, 947	269, 291	3, 558, 367	12, 430, 656	15, 989, 023	12, 157, 956	
120, 563	357, 432	6, 964, 361	479, 218	3, 011, 428	6, 485, 143	9, 496, 571	12, 508, 898	
195, 151	568, 188	10, 539, 375	1, 586, 220	4, 864, 648	8, 953, 155	13, 817, 803	12, 866, 020	
231, 487	536, 546	10, 828, 125	2, 057, 487	5, 371, 130	8, 770, 638	14, 141, 768	13, 205, 429	
121, 770	282, 575	10, 828, 125	701, 862	3, 065, 216	10, 126, 263	13, 191, 479	13, 615, 826	
236, 799	698, 616	10, 106, 250	416, 736	7, 427, 664	9, 689, 514	17, 117, 178	14, 019, 343	
163, 956	462, 025	10, 828, 125	2, 355, 754	4, 974, 928	8, 472, 371	13, 447, 299	14, 420, 731	
353, 201	1, 099, 651	14, 437, 500	768, 075	10, 759, 994	13, 669, 425	24, 429, 419	14, 814, 243	. 96
177, 737	661, 377	4, 331, 250	1, 442, 989	6, 121, 354	2, 888, 261	9, 009, 615	15, 270, 483	
76, 516	168, 051	10, 106, 250	1, 844, 167	2, 484, 327	8, 262, 083	10, 746, 410	15, 711, 264	
249, 927	758, 576	9, 384, 375	2, 610, 649	7, 561, 544	6, 773, 726	14, 335, 270	16, 120, 891	
184, 414	601, 039	10, 106, 250	4, 782, 723	5, 785, 307	5, 323, 527	11, 108, 834	16, 599, 492	

TABLE IV.—*Imports, exports, cost, production, and consumption of refined*

Years.	Foreign.			Value of foreign refined sugar consumed.		
	Imports.	Exports.	Difference.	Average price per pound.	Value.	Rate of duty.
SIXTH DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1840	12, 985, 704	9, 156, 314	3, 829, 390	.008	33, 740	([9])
1841	18, 301, 798	9, 758, 699	8, 543, 099	.054	465, 914	([9])
1842	18, 448, 609	7, 581, 589	10, 867, 020	.053	582, 108	([9])
1843	[6]1, 797, 115	350, 500	1, 446, 615	.057	82, 769	([9])
1844	6, 947, 033	2, 927, 067	4, 019, 966	.044	178, 258	([9])
1845	3, 707, 436	2, 600, 548	1, 106, 888	.043	47, 751	([9])
1846	1, 297, 214	1, 222, 609	74, 605	.076	5, 670	([9])
1847	10, 285, 583	2, 638, 658	7, 646, 925	.046	353, 312	.012 and 30 p. c.
1848	8, 928, 636	1, 506, 640	7, 421, 996	.054	407, 694	30 p. c...
1849	5, 503, 756	2, 292, 948	3, 210, 808	.036	118, 659	30 p. c...
SEVENTH DECENNIUM.						
1850	20, 773, 529	1, 966, 952	18, 806, 577	.040	767, 178	30 p. c...
1851	16, 864, 163	2, 591, 483	14, 272, 680	.054	784, 086	30 p. c...
1852	7, 198, 498	1, 513, 048	5, 685, 450	.032	185, 642	30 p. c...
1853	7, 890, 037	907, 768	6, 982, 269	.037	48, 869	30 p. c...
1854	6, 357, 544	2, 183, 570	4, 173, 974	....	([8])	30 p. c...
1855	5, 449, 262	4, 054, 884	1, 394, 378	....	([8])	30 p. c...
1856	2, 364, 611	2, 411, 224	—46, 613	....	([8])	30 p. c...
1857	1, 937, 027	2, 563, 142	—626, 115	....	([8])	30 p. c...
1858	1, 767, 074	2, 766, 536	—999, 462	....	([8])	24 p. c...
1859	1, 364, 233	4, 202, 721	—2, 838, 488	....	([8])	24 p. c...
EIGHTH DECENNIUM.						
1860	1, 806, 973	5, 022, 388	—3, 215, 415	....	([8])	24 p. c...
1861	2, 014, 800	5, 518, 546	—3, 503, 746	....	([8])	24 p. c...
1862	28, 853, 646	4, 833, 586	24, 020, 060	.035	853, 877	([9])
1863	65, 695, 464	8, 887, 719	56, 807, 745	.03	1, 713, 249	([9])
1864	58, 503, 452	4, 944, 979	53, 558, 473	.042	2, 254, 467	([9])
1865	102, 593, 694	2, 194, 821	100, 398, 873	.041	4, 126, 007	([9])
1866	160, 538, 677	4, 666, 426	155, 872, 251	.046	7, 311, 616	([9])
1867	70, 782, 278	5, 230, 174	65, 552, 104	.051	[7]3, 493, 392	([9])
1868	87, 388, 008	585, 958	86, 802, 050	.055	3, 885, 604	([9])
1869	1, 209, 857	789, 751	420, 106	.061	4, 214, 420	([9])
NINTH DECENNIUM.						
1870	151, 520	353, 014	—201, 494	.061	5, 446, 274	([9])
1871	1, 204, 180	59, 198	1, 144, 982	.061	6, 439, 373	([9])
1872	217, 481	244, 236	— 26, 755	.063	5, 457, 380	([9])
1873	509, 504	404, 642	104, 862	.064	4, 284, 239	([9])
1874	39, 279	398, 049	—358, 770	.059	1, 769, 130	([9])
1875	15, 251	123, 153	—107, 902	.054	1, 361, 390	([9])
1876	19, 931	121, 215	—101, 284	.052	378, 879	([9])
1877	308, 688	6, 733	301, 955	.048	227, 715	([9])
1878	....	....	....	....	....	....

[1] These imports are for calendar years and not fiscal years.
[2] The hogsheads, tierces, and barrels in which a part of the sugar was exported in these years were
[3] These imports are estimated by taking the mean between 1819 and 1821.
[4] From 1836 to 1839 a small quantity of candy is included in the imports and exports.
[5] For 1807 and 1815 the price per pound of the *imports* is taken, and not the average price per pound
[6] These statistics are for nine months only, from October 1, 1842, to June 30, 1843.
[7] Beginning with 1867, the "Consumption" of refined sugar, with its "Value" and "Paid for customs," by subtracting the exports from the imports and the "Value" and "Paid for customs" are calculated
[8] From 1854 to 1861, inclusive, the exports exceed the imports.
[9] The rates of duty on refined sugar vary according to the grades and qualities imported.

sugar in the United States for each fiscal year, from 1790 *to* 1878—Continued.

Value of foreign refined sugar consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Lbs.*
119, 973	153, 713	16, 603, 125	10, 741, 648	3, 829, 390	5, 106, 643	8, 936, 033	17, 070, 240	
287, 593	753, 507	12, 680, 250	13, 435, 084	8, 543, 099	....	8, 543, 099	17, 563, 990	
416, 391	998, 499	13, 117, 500	3, 430, 346	10, 867, 020	9, 687, 154	20, 554, 174	18, 065, 813	
94, 839	177, 608	20, 405, 000	598, 884	1, 446, 615	19, 806, 116	21, 252, 731	18, 603, 956	
114, 967	293, 225	16, 625, 430	1, 671, 107	4, 019, 966	14, 954, 323	18, 974, 289	19, 102, 946	
54, 271	102, 022	29, 150, 000	1, 997, 992	1, 106, 888	27, 152, 008	28, 258, 896	19, 640, 029	1. 14
2, 462	8, 132	21, 109, 500	4, 128, 512	74, 605	16, 980, 988	17, 055, 593	20, 225, 760	
92, 100	445, 412	20, 405, 000	1, 539, 415	7, 646, 925	18, 865, 585	26, 512, 510	20, 869, 760	
122, 308	530, 002	34, 980, 000	3, 378, 773	7, 421, 996	31, 601, 227	39, 023, 223	21, 609, 554	
35, 598	154, 257	32, 400, 000	1, 956, 895	3, 210, 808	30, 443, 105	33, 653, 913	22, 358, 293	
230, 153	997, 331	36, 816, 566	2, 786, 022	18, 806, 577	34, 030, 544	52, 837, 121	23, 191, 876	
235, 226	1, 019, 312	31, 363, 349	2, 689, 541	14, 272, 680	28, 673, 808	42, 946, 488	23, 974, 993	
55, 691	241, 333	35, 127, 230	2, 096, 770	5, 685, 450	33, 030, 460	38, 715, 910	24, 843, 547	
14, 661	63, 530	47, 807, 199	5, 155, 057	1, 320, 782	42, 652, 142	43, 972, 924	25, 721, 956	
....	....	65, 488, 973	4, 789, 411	....	60, 699, 562	60, 699, 562	26, 615, 328	1. 51
....	....	50, 522, 051	7, 098, 320	....	43, 423, 731	43, 423, 731	27, 586, 113	
....	....	33, 730, 485	4, 100, 372	....	29, 630, 113	29, 630, 113	28, 349, 746	
....	....	10, 925, 685	3, 141, 835	....	7, 783, 850	7, 783, 850	29, 124, 515	
....	....	41, 692, 331	1, 790, 865	....	39, 901, 466	39, 901, 466	29, 966, 042	
....	....	53, 495, 269	3, 976, 039	....	49, 519, 230	49, 519, 230	30, 685, 586	
....	....	32, 756, 063	3, 332, 045	....	29, 424, 018	29, 424, 018	31, 443, 321	
....	....	33, 776, 807	3, 236, 110	....	30, 540, 697	30, 540, 697	32, 238, 403	
533, 103	1, 386, 980	68, 980, 412	1, 470, 403	24, 020, 060	67, 510, 009	91, 530, 069	32, 987, 985	
1, 308, 767	3, 022, 016	30, 030, 000	3, 214, 661	56, 807, 745	26, 815, 339	83, 623, 084	33, 211, 430	
1, 269, 603	3, 524, 070	10, 982, 543	1, 803, 332	53, 558, 473	5, 632, 260	59, 190, 733	33, 345, 224	2. 27
3, 560, 669	7, 686, 676	1, 485, 341	1, 653, 557	100, 398, 873	....	100, 398, 873	33, 394, 882	
5, 584, 762	12, 896, 378	2, 584, 010	3, 990, 477	155, 872, 251	....	155, 872, 251	34, 324, 665	
2, 445, 528	5, 938, 920	5, 863, 000	7, 835, 268	68, 370, 576	....	68, 370, 575	35, 342, 849	
2, 545, 700	6, 431, 304	5, 383, 521	2, 214, 207	70, 174, 980	3, 169, 314	73, 344, 294	36, 361, 669	
2, 480, 283	6, 694, 703	14, 257, 684	3, 151, 166	68, 793, 995	11, 106, 518	79, 900, 513	37, 400, 130	
3, 151, 837	8, 598, 111	13, 053, 199	4, 415, 100	88, 605, 483	8, 638, 099	97, 243, 582	38, 558, 371	
3, 319, 124	9, 758, 497	22, 165, 315	3, 797, 278	105, 559, 303	2, 381, 893	107, 941, 196	39, 723, 755	
2, 404, 350	7, 861, 730	22, 035, 919	4, 461, 427	85, 687, 870	....	85, 687, 870	40, 967, 095	
1, 862, 971	6, 147, 210	18, 801, 974	9, 870, 738	66, 613, 627	....	66, 613, 627	42, 265, 762	
828, 987	2, 598, 117	15, 486, 168	15, 269, 532	29, 713, 245	....	29, 713, 245	43, 456, 931	1. 23
723, 850	2, 085, 240	23, 538, 321	35, 086, 871	24, 938, 459	....	24, 938, 459	44, 588, 083	
248, 949	627, 828	34, 317, 795	51, 840, 977	7, 164, 166	....	7, 164, 166	45, 687, 668	
161, 331	389, 046	40, 041, 240	53, 678, 016	4, 661, 512	....	4, 661, 512	46, 761, 551	
....	....	....	....	....	....	....	47, 874, 485	

reduced at the rate of 1,050 pounds to a hogshead.

of the *difference*. The figures are quoted from "Pitkin's Commerce of the United States."

is taken from the Annual Reports on Commerce and Navigation. Previous to that year it is obtained on the same.

TABLE V.—*Imports, exports, cost, and consumption of foreign*

Years.	Foreign.			Value of foreign candy consumed.		
	Imports.	Exports.	Difference.	Average price per pound.	Value.	Rate of duty.
SIXTH DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1840	530	(2)	...	.094	50	.12
1841	114	...	...	.298	34	.12
1842	1,289	...	...	.10	129	.12
1843	[1]3,919	...	...	.086	339	.06
1844	4,117	...	...	.094	391	.06
1845	1,704	...	...	.095	162	.06
1846	1,236	...	...	.304	376	.06
1847	1,153	...	...	.165	191	30 p. c.
1848	8,477	...	...	.104	889	30 p. c.
1849	4 885	...	...	.094	461	30 p. c.
SEVENTH DECENNIUM.						
1850	8,291	...	...	.355	2,951	30 p. c.
1851	21,280	...	...	.21	4,469	30 p. c.
1852	33,451	...	...	.164	5,511	30 p. c.
1853	24,995	...	...	.206	5,172	30 p. c.
1854	35,867	15,595	20,272	.120	2,442	30 p. c.
1855	74,371	1,250	73,121	.120	8,792	30 p. c.
1856	36,324	575	35,749	.115	4,123	30 p. c.
1857	18,853	...	18,853	.10	1,887	30 p. c.
1858	40,558	4,500	36,058	.045	1,658	24 p. c.
1859	22,053	1,085	20,968	.051	1,083	24 p. c.
EIGHTH DECENNIUM.						
1860	41,598	5,278	36,320	.069	2,539	24 p. c.
1861	63,531	6,207	57,324	.158	9,094	.08 and 24 p. c.
1862	3,655	280	3,375	.108	366	.08
1863	9,162	1,710	7,452	.085	638	.06
1864	18,365	13,037	5,328	.158	842	.06
1865	35,388	8,206	27,182	.029	810	.10
1866	21,685	12,320	9,365	.56	5,250	(4)
1867	54,905	206	54,699	.288	[3]35,531	(4)
1868	32,255	1,028	31,227	.32	12,691	(4)
1869	51,941	290	51,651	.237	9,302	(4)
NINTH DECENNIUM.						
1870	55,820	574	55,246	.285	17,673	(4)
1871	51,356	1,525	49,831	.257	11,735	(4)
1872	63,833	1,950	61,883	.294	18,326	(4)
1873	89,285	3,414	85,871	.226	15,441	(4)
1874	56,443	938	55,505	.247	13,768	(4)
1875	76,816	460	76,356	.218	18,690	(4)
1876	87,955	4,093	83,862	.210	18,454	(4)
1877	40,868	1,605	39,263	.143	8,313	(4)
1878	...	...	...	...	...	...

[1] These imports are from October 1, 1842, to June 30, 1843, a period of nine months, which was occasioned by changing the time of the fiscal year.

[2] Previous to 1840 there were 9,832 pounds of candy imported and 8,462 pounds exported, which have been included in refined sugar in their respective years.

candy in the United States for each fiscal year from 1840 *to* 1878.

Value of foreign candy consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*		*Pounds.*	*Pounds.*			*Number.*	
64	114	......	......	530	......	......	17, 070, 240	......
14	48	......	......	114	......	......	17, 563, 990	......
155	284	......	......	1, 289	......	......	18, 065, 813	......
235	574	......	......	3, 919	......	......	18, 603, 956	......
247	638	......	......	4, 117	......	......	19, 102, 946	......
102	264	......	......	1, 704	......	......	19, 640, 029	......
74	450	......	......	1, 236	......	......	20, 225, 760	......
57	248	......	......	1, 153	......	......	20, 869, 760	......
267	1, 156	......	......	8, 477	......	......	21, 609, 554	......
138	599	......	......	4, 885	......	......	22, 358, 293	......
885	3, 836	......	......	8, 291	......	......	23, 191, 876	......
1, 341	5, 810	......	......	21, 280	......	......	23, 974, 993	......
1, 653	7, 164	......	......	33, 451	......	......	24, 843, 547	......
1, 552	6, 724	......	......	24, 995	......	......	25, 721, 956	......
733	3, 175	......	......	20, 272	......	......	26, 615, 328	......
2, 638	11, 430	......	......	73, 121	......	......	27, 586, 113	......
1, 237	5, 360	......	......	35, 749	......	......	28, 349, 746	......
566	2, 453	......	......	18, 853	......	......	29, 124, 515	......
398	2, 056	......	......	36, 058	......	......	29, 966, 042	......
260	1, 343	......	......	20, 968	......	......	30, 685, 586	......
609	3, 148	......	......	36, 320	......	......	31, 443, 321	......
3, 857	12, 951	......	......	57, 324	......	......	32, 238, 403	......
270	636	......	......	3, 375	......	......	32, 987, 985	......
447	1, 085	......	......	7, 452	......	......	33, 211, 430	......
320	1, 162	......	......	5, 328	......	......	33, 345, 224	......
2, 718	3, 528	......	232, 145	27, 182	......	......	33, 394, 882	......
2, 288	12, 518	......	......	9, 365	......	......	34, 324, 665	......
[3]19, 289	54, 820	......	67, 375	[3]120, 450	......	......	35, 342, 849	......
6, 989	19, 680	......	64, 505	45, 255	......	......	36, 361, 660	......
5, 429	14, 731	......	20, 470	34, 444	......	......	37, 400, 130	......
9, 996	27, 669	......	73, 645	62, 968	......	......	38, 558, 371	......
7, 160	18, 895	......	104, 845	46, 510	......	......	39, 723, 755	......
10, 684	29, 010	......	112, 440	65, 016	......	......	40, 967, 095	......
10, 363	25, 804	......	139, 365	73, 669	......	......	42, 265, 762	......
8, 516	22, 284	......	152, 965	55, 737	......	......	43, 456, 931	......
11, 972	30, 662	......	245, 565	61, 095	......	......	44, 588, 083	......
12, 500	30, 954	......	161, 225	86, 865	......	......	45, 687, 668	......
6, 173	14, 486	......	309, 460	47, 906	......	......	46, 761, 551	......
......	......	......	......	......	......	......	47, 874, 485	......

[3] Beginning with the year 1867 the "Value," "Paid for Customs," and "Consumption" of candy are taken from the Annual Reports on Commerce and Navigation.

[4] The rate of duty for the years 1866 to 1878 inclusive are 10 and 15 cents per pound and 50 per cent. according to the quality of the candy. Act of Congress, June 30, 1864.

TABLE VI.—*Imports, exports, cost, and consumption of melado or sirup*

Years.	Foreign.			Value of melado consumed.		
	Imports.	Exports.	Difference.	Price per pound.	Value.	Rate of duty.
SIXTH DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Cents.*
1840	10	(1)		.30		
1841						
1842						
1843	(2) 3,685			.015		
1844	54			.037		
1845	112			.027		
1846	2,729			.058		
1847	897			.112		
1848	6,631			.133		
1849	2,458			.154		
SEVENTH DECENNIUM.						
1850	5,416			.084		
1851	265			.17		
1852	2			.50		
1853	1,622			.034		
1854	50,732			.039		
1855	53,143			.053		
1856	48,574			.092		
1857	115,420			.037		
1858	204,689	465,410	—260,721	.03		
1859	255,984			.077		
EIGHTH DECENNIUM.						
1860	86,352			.065		
1861	601,551	1,064,285	—462,734	.024		
1862						
1863	3,527,224			.025	63,854	.02
1864		973,080				
1865	7,160,855			.03		
1866	5,269,623	792,365	4,477,258	.031	138,795	.025
1867	1,481,363			.030	(3) 87,194	.025
1868	5,647,757	1,014,295	4,633,462	.032	113,630	.025
1869	17,294,314	150,420	17,143,894	.034	387,662	.025
NINTH DECENNIUM.						
1870	36,161,935	1,738,185	34,423,750	.036	1,231,427	.025
1871	87,113,535	3,569,746	83,543,789	.037	2,454,696	.015
1872	51,673,375	49,139	51,624,236	.040	2,693,240	.015
1873	113,670,829	2,248,910	111,421,919	.042	4,504,764	.015
1874	106,952,236	5,786,380	101,165,856	.040	5,398,380	.015
1875	101,768,386	746,922	101,021,464	.034	2,489,898	.015
1876	79,702,878	3,145,520	76,557,358	.032	3,151,184	.018
1877	39,461,057	36,996	39,424,061	.038	1,923,427	.018
1878						

(1) From 1840 to 1861, inclusive, the exports exceed the imports; the reason of this is that melado or sirup of sugar-cane was frequently entered for importation under the name of molasses. Previous to 1840 the only entries on record under their proper heading are 1,182 pounds imported, and 3,731 pounds exported. These quantities have been added to brown sugar in their respective years.

of sugar-cane in the United States for each fiscal year from 1790 *to* 1878.

Value of melado consumed.		Consumption.	Production.				
Paid for customs.	Total.		Years.	Maple.	Years.	Maple.	Sorghum.
Dollars.	*Dollars.*	*Pounds.*		*Pounds.*		*Pounds.*	*Pounds.*
.....	.....	.....	1790	12,000,000	1840	35,105,705	.....
.....	.....	.....	1791	13,000,000	1841	34,000,000	.....
.....	.....	.....	1792	11,000,000	1842	37,337,795	.....
.....	.....	.....	1793	14,000,000	1843	37,000,000	.....
.....	.....	.....	1794	16,000,000	1844	18,000,000	.....
.....	.....	.....	1795	13,000,000	1845	40,779,000	.....
.....	.....	.....	1796	15,000,000	1846	24,495,652	.....
.....	.....	.....	1797	12,000,000	1847	28,762,000	.....
.....	.....	.....	1798	14,000,000	1848	32,670,570	.....
.....	.....	.....	1799	16,000,000	1849	33,572,000	.....
.....	.....	.....	1800	15,000,000	1850	34,253,436	.....
.....	.....	.....	1801	17,000,000	1851	32,142,000	.....
.....	.....	.....	1802	16,000,000	1852	29,500,000	.....
.....	.....	.....	1803	14,000,000	1853	27,000,000	.....
.....	.....	.....	1804	15,000,000	1854	25,371,800	.....
.....	.....	.....	1805	17,000,000	1855	22,211,172	.....
.....	.....	.....	1806	19,000,000	1856	26,000,000	.....
.....	.....	.....	1807	18,000,000	1857	27,000,000	.....
.....	.....	.....	1808	17,000,000	1858	33,000,000	875
.....	.....	.....	1809	19,000,000	1859	38,000,000	10,000
.....	.....	.....	1810	23,000,000	1860	40,120,205	40,400
.....	.....	.....	1811	20,603,070	1861	42,000,000	80,500
.....	.....	.....	1812	22,000,000	1862	44,000,000	137,430
51,082	114,936	2,554,144	1813	22,500,000	1863	41,500,000	183,795
.....	.....	.....	1814	24,000,000	1864	40,500,000	208,300
.....	.....	7,160,855	1815	21,000,000	1865	39,740,796	280,330
111,931	250,726	4,477,258	1816	23,000,000	1866	37,532,000	511,565
(3) 72,494	159,688	(3) 2,899,768	1817	21,000,000	1867	35,654,000	140,658
88,570	202,200	3,542,817	1818	23,000,000	1868	33,421,000	200,676
278,672	666,334	11,146,867	1819	25,000,000	1869	29,114,500	224,000
832,694	2,064,121	33,307,758	1820	24,000,000	1870	28,443,645	109,940
1,060,976	3,515,672	65,442,264	1821	26,000,000	1871	30,756,000	117,525
988,678	3,681,918	65,911,871	1822	28,000,000	1872	31,682,000	172,995
1,606,270	6,111,034	107,084,690	1823	23,000,000	1873	32,157,000	184,230
1,998,793	7,397,173	133,252,852	1824	27,000,000	1874	33,044,200	182,050
1,269,442	3,759,340	73,145,139	1825	29,000,000	1875	43,197,930	108,840
1,813,354	4,964,538	96,751,914	1826	33,000,000	1876	43,288,080	97,420
930,944	2,854,371	49,650,354	1827	35,000,000	1877	41,000,000	80,760
.....	.....	.....	1828	31,000,000	1878	.....	.....
			1829	34,300,000	.....	.....	.....
			1830	35,000,000			
			1831	37,000,000			
			1832	34,500,000			
			1833	36,000,000			
			1834	35,000,000			
			1835	37,000,000			
			1836	37,500,000			
			1837	40,000,000			
			1838	38,000,000			
			1839	37,000,000			

The production of maple sugar since 1840 has been determined by references to the United States census reports, the reports of various State and agricultural societies, and other sources; previous to that date it has been estimated from American and English agricultural and historical works. It is very evident the actual crop exceeded the above figures, but a greater error would be made by omitting such estimates than in accepting them. The production of sorghum sugar has been found from the State reports.

(2) These imports are from October 1, 1842, to June 30, 1843, nine months.
(3) Beginning with the year 1867 the "Value," "Paid for Customs," and "Consumption" of melado are taken from the Annual Reports on Commerce and Navigation.

TABLE VII.—*Imports, exports, cost, production, and consumption of brown and*

Years.	Foreign.			Value of foreign sugar consumed.		
	Imports.	Exports.	Difference.	Average price per pound.	Value.	Average rate of duty.
FIRST DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*		*Dollars.*	
1790	18,229,419	49,787	18,179,632		(3)	
1791	24,901,639	75,661	24,825,978			
1792	[1] 24,420,372	1,197,916	23,222,456			
1793	[1] 47,762,505	4,611,988	43,150,517			
1794	[1] 48,705,900	20,762,221	27,943,679			
1795	63,783,405	22,117,267	41,666,138			
1796	59,469,154	35,832,790	23,636,364			
1797	72,765,821	38,570,051	34,195,770			
1798	87,523,918	51,740,717	35,783,201			
1799	103,846,468	79,054,040	24,792,428			
SECOND DECENNIUM.						
1800	113,339,751	56,557,455	56,782,296			
1801	136,628,936	97,734,211	38,894,725			
1802	98,630,775	61,180,288	37,450,487			
1803	73,822,203	23,226,453	50,595,750			
1804	128,722,669	74,172,220	54,550,449			
1805	186,471,773	122,808,993	63,662,780			
1806	199,133,437	145,630,841	53,502,596			
1807	220,669,099	143,119,605	77,549,494		7,999,772	
1808	104,411,777	28,962,527	75,459,250			
1809	76,753,394	45,297,338	31,456,056			
THIRD DECENNIUM.						
1810	55,104,722	47,024,002	8,080,720			
1811	77,200,594	18,268,347	58,932,247			
1812	83,409,956	13,927,277	69,482,679			
1813	33,397,038	6,617,288	26,779,750			
1814	29,464,943	762	29,464,181			
1815	45,043,162	3,188,718	41,854,444		6,913,370	
1816	55,110,381	17,723,967	37,386,414			
1817	93,147,368	20,195,168	72,952,200			
1818	68,358,936	22,057,904	46,301,032			
1819	73,944,657	11,267,182	62,677,475			
FOURTH DECENNIUM.						
1820	[2] 66,730,179	31,389,109	35,341,070			
1821	59,515,701	20,061,725	39,453,976			
1822	88,310,686	14,446,860	73,863,826			
1823	60,791,470	21,459,024	39,332,446		1,779,881	
1824	94,452,057	14,128,429	80,323,628		4,171,756	
1825	71,772,468	21,836,771	49,935,697		2,617,965	
1826	84,935,959	21,146,856	63,789,103		3,569,929	
1827	76,702,280	15,343,530	61,358,750		3,385,958	
1828	56,936,418	10,691,088	46,245,330		2,718,296	
1829	63,308,621	12,343,478	50,965,143		2,807,599	
FIFTH DECENNIUM.						
1830	86,490,113	9,725,342	76,764,771		3,946,547	
1831	109,231,168	22,580,947	86,650,221		3,639,488	
1832	66,488,891	17,536,028	48,952,863		2,001,303	
1833	97,734,438	6,619,154	91,115,284		4,329,474	
1834	115,392,096	13,969,203	101,422,893		4,703,312	
1835	126,038,333	7,257,476	118,780,857		6,243,350	
1836	191,428,305	34,492,282	156,938,023		9,681,940	
1837	136,149,761	41,124,819	95,024,942		4,546,128	
1838	153,883,863	11,624,324	142,259,539		6,697,656	
1839	195,289,024	13,154,653	182,134,371		8,939,000	

refined cane-sugar in the United States for each fiscal year, from 1790 *to* 1878.

Value of foreign sugar consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Lbs.*
185, 649	....	....	....	18, 179, 632	....	18, 179, 632	3, 929, 214	
383, 234	....	....	....	24, 825, 978	....	24, 825, 978	4, 049, 247	
355, 969	....	200, 000	....	23, 222, 456	200, 000	23, 422, 456	4, 172, 945	
688, 812	....	215, 000	....	43, 150, 517	215, 000	43, 365, 517	4, 300, 425	
469, 847	....	240, 000	....	27, 943, 679	240, 000	28, 183, 679	4, 431, 802	
651, 101	....	290, 000	....	41, 666, 138	290, 000	41, 956, 138	4, 567, 292	6. 64
355, 789	....	340, 000	....	23, 636, 364	340, 000	23, 976, 364	4, 706, 926	
589, 567	....	400, 000	....	34, 195, 770	400, 000	34, 595, 770	4, 850, 718	
611, 247	....	499, 500	....	35, 783, 201	499, 500	36, 282, 701	4, 998, 706	
3, 026, 964	....	600, 000	....	24, 792, 428	600, 000	25, 392, 428	5, 151, 117	
1, 272, 833	....	1, 000, 000	....	56, 782, 296	1, 000, 000	57, 782, 296	5, 308, 483	
978, 401	....	3, 000, 000	....	38, 894, 725	3, 000, 000	41, 894, 725	5, 475, 385	
689, 446	....	5, 000, 000	....	37, 450, 487	5, 000, 000	42, 450, 487	5, 647, 854	
1, 235, 077	....	6, 200, 000	97, 029	50, 595, 750	6, 102, 971	56, 698, 721	5, 825, 758	
1, 573, 714	....	7, 499, 500	924, 181	54, 550, 449	6, 575, 319	61, 125, 768	6, 009, 469	
1, 544, 023	....	8, 299, 500	390, 445	63, 662, 780	7, 909, 055	71, 571, 835	6, 198, 858	10. 06
1, 396, 316	....	9, 000, 000	510, 578	53, 502, 596	8, 489, 422	61, 992, 018	6, 394, 211	
1, 993, 139	9, 992, 911	10, 000, 000	139, 986	77, 549, 494	9, 860, 014	87, 409, 508	6, 595, 718	
1, 763, 008	....	14, 000, 000	20, 362	75, 459, 250	13, 979, 638	89, 438, 888	6, 803, 567	
752, 126	....	15, 000, 000	287, 921	31, 456, 056	14, 712, 079	46, 168, 135	7, 018, 007	
410, 452	....	16, 000, 000	762, 321	8, 080, 720	15, 237, 679	23, 318, 399	7, 239, 881	
1, 502, 465	....	18, 000, 000	244, 242	58, 932, 247	17, 755, 758	76, 688, 005	7, 449, 832	
1, 765, 403	....	19, 000, 000	142, 690	69, 482, 679	18, 857, 310	88, 339, 989	7, 665, 973	
1, 364, 527	....	20, 000, 000	732, 320	26, 779, 750	19, 267, 680	46, 047, 430	7, 888, 280	
1, 503, 279	....	21, 000, 000	756	29, 464, 181	20, 999, 244	50, 463, 425	8, 117, 036	
2, 130, 779	9, 044, 149	22, 000, 000	16, 692	41, 854, 444	21, 983, 308	63, 837, 752	8, 352, 429	8. 03
1, 911, 861	....	23, 000, 000	79, 577	37, 386, 414	22, 920, 423	60, 306, 837	8, 595, 645	
2, 225, 944	....	24, 000, 000	180, 863	72, 852, 200	23, 819, 137	96, 671, 337	8, 845, 887	
1, 415, 565	....	24, 500, 000	111, 894	46, 301, 032	24, 388, 106	70, 689, 138	9, 103, 354	
1, 911, 250	....	25, 000, 000	80, 055	62, 677, 475	24, 919, 945	87, 597, 420	9, 365, 460	
1, 076, 982	....	27, 000, 000	80, 836	35, 341, 070	26, 919, 164	62, 260, 234	9, 638, 453	
1, 202, 360	....	29, 000, 000	181, 119	39, 453, 976	28, 818, 881	68, 272, 857	9, 917, 091	
2, 268, 782	....	30, 000, 000	185, 658	73, 863, 826	29, 814, 342	103, 678, 168	10, 205, 555	
1, 189, 907	2, 969, 788	34, 650, 000	59, 033	39, 332, 446	34, 590, 967	73, 923, 413	10, 504, 195	
2, 500, 127	6, 671, 883	36, 960, 000	63, 868	80, 323, 628	36, 896, 132	117, 219, 760	10, 813, 777	
1, 507, 043	4, 125, 008	34, 650, 000	77, 799	49, 935, 697	34, 572, 201	84, 507, 898	11, 132, 991	9. 28
1, 961, 327	5, 531, 247	51, 975, 000	226, 016	63, 789, 103	51, 748, 984	115, 538, 087	11, 459, 903	
1, 872, 943	5, 258, 901	82, 005, 000	255, 447	61, 358, 750	81, 749, 553	143, 108, 303	11, 803, 775	
1, 422, 184	4, 140, 480	101, 599, 575	323, 326	46, 245, 330	101, 276, 249	147, 521, 579	12, 157, 956	
1, 559, 174	4, 366, 773	55, 714, 890	532, 996	50, 965, 143	55, 181, 894	106, 147, 037	12, 508, 898	
2, 352, 155	6, 298, 702	84, 315, 000	1, 623, 866	76, 764, 771	82, 691, 134	159, 455, 905	12, 866, 020	
2, 669, 860	6, 309, 348	86, 625, 000	2, 237, 619	86, 650, 221	84, 387, 381	171, 037, 602	13, 205, 429	
1, 498, 399	3, 499, 702	86, 625, 000	856, 022	48, 952, 863	85, 768, 978	134, 721, 841	13, 615, 826	
2, 328, 990	6, 658, 464	80, 850, 000	517, 076	91, 115, 284	80, 332, 924	171, 448, 208	14, 019, 343	
2, 575, 155	7, 278, 467	86, 625, 000	2, 463, 841	101, 422, 893	84, 161, 159	185, 584, 052	14, 420, 731	
3, 053, 723	9, 297, 073	115, 500, 000	870, 506	118, 780, 857	114, 629, 494	233, 410, 351	14, 814, 243	12. 89
3, 948, 104	13, 630, 044	34, 650, 000	1, 571, 108	156, 938, 023	33, 078, 892	190, 016, 915	15, 270, 483	
2, 390, 031	6, 936, 159	80, 850, 000	2, 150, 769	95, 024, 942	78, 699, 231	173, 724, 173	15, 711, 264	
3, 617, 377	10, 315, 033	75, 075, 000	3, 019, 451	142, 259, 539	72, 055, 549	214, 315, 088	16, 120, 891	
4, 593, 141	13 532, 141	80, 850, 000	5, 169, 926	182, 134, 371	75, 680, 074	257, 814, 445	16, 599, 492	

TABLE VII.—*Imports, exports, cost, production, and consumption of*

Years.	Foreign.			Value of foreign sugar consumed.		
	Imports.	Exports.	Difference.	Average price per pound.	Value.	Average rate of duty.
SIXTH DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*		*Dollars.*	
1840	120, 940, 737	18, 947, 018	101, 993, 719	....	4, 223, 704	....
1841	184, 264, 881	11, 814, 266	172, 450, 615	....	7, 950, 774	....
1842	173, 863, 555	12, 897, 703	160, 965, 852	....	5, 773, 168	....
1843	[4]71, 331, 446	1, 886, 976	69, 444, 470	....	2, 439, 063	....
1844	186, 804, 524	4, 475, 032	182, 329, 492	....	6, 884, 110	....
1845	115, 664, 840	13, 799, 637	101, 865, 203	....	4, 063, 040	....
1846	128, 028, 875	20, 570, 023	107, 458, 852	....	4, 324, 186	....
1847	236, 968, 844	8, 394, 918	228, 573, 926	....	9, 406, 253	....
1848	257, 129, 753	13, 120, 769	244, 008, 984	....	8, 774, 883	....
1849	259, 319, 241	17, 149, 994	242, 169, 247	....	7, 275, 780	....
SEVENTH DECENNIUM.						
1850	218, 425, 348	14, 153, 065	204, 272, 283	....	6, 950, 716	....
1851	380, 402, 024	6, 387, 108	374, 014, 916	....	13, 478, 709	....
1852	457, 511, 091	9, 573, 357	447, 937, 734	....	13, 919, 196	....
1853	464, 410, 664	18, 981, 701	445, 418, 963	....	13, 929, 295	....
1854	455, 877, 853	52, 003, 989	403, 873, 864	....	12, 464, 666	....
1855	473, 756, 704	33, 715, 073	440, 041, 631	....	13, 314, 713	....
1856	545, 177, 856	23, 340, 899	521, 836, 957	....	21, 369, 736	....
1857	776, 868, 842	14, 731, 801	762, 137, 041	....	41, 730, 011	....
1858	518, 995, 698	74, 440, 714	444, 554, 984	....	19, 082, 260	....
1859	655, 590, 378	33, 607, 568	621, 982, 810	....	28, 669, 343	....
EIGHTH DECENNIUM.						
1860	694, 751, 845	34, 010, 792	660, 741, 053	....	29, 288, 548	....
1861	809, 148, 407	79, 338, 222	729, 810, 185	....	27, 245, 863	....
1862	557, 139, 529	23, 551, 865	533, 587, 664	....	19, 049, 415	....
1863	518, 594, 861	16, 153, 847	502, 441, 014	....	17, 577, 745	....
1864	632, 230, 247	26, 285, 596	605, 944, 651	....	27, 068, 297	....
1865	644, 775, 639	30, 735, 278	614, 040, 361	....	23, 695, 542	....
1866	994, 785, 401	7, 775, 407	987, 009, 994	....	40, 038, 004	....
1867	847, 572, 643	12, 210, 501	835, 362, 142	....	[5]38, 390, 330	....
1868	1, 115, 541, 658	15, 097, 495	1, 100, 444, 163	....	43, 307, 769	....
1869	1, 230, 539, 116	17, 677, 968	1, 212, 861, 148	....	47, 861, 696	....
NINTH DECENNIUM.						
1870	1, 160, 611, 634	16, 595, 143	1, 144, 016, 491	....	59, 021, 588	....
1871	1, 190, 360, 118	6, 792, 890	1, 183, 567, 228	....	58, 382, 939	....
1872	1, 457, 512, 299	12, 071, 191	1, 445, 441, 108	....	73, 318, 299	....
1873	1, 454, 633, 763	21, 678, 129	1, 432, 955, 634	....	74, 993, 073	....
1874	1, 594, 345, 633	13, 523, 459	1, 580, 822, 174	....	76, 079, 703	....
1875	1, 695, 741, 604	10, 453, 475	1, 685, 288, 129	....	69, 292, 010	....
1876	1, 414, 274, 594	12, 720, 987	1, 401, 553, 607	....	63, 860, 713	....
1877	1, 584, 471, 612	3, 084, 355	1, 581, 387, 257	....	71, 849, 089	....
1878	....	....	....	....	....	....

[1] These imports are for calendar years and not fiscal years.
[2] Estimated by taking the mean between 1819 and 1821, there being no statistics of imports on record for this year.
[3] The only reliable values on record from 1790 to 1823 are those of 1807 and 1815, which are found in "Pitkin's Commerce of the United States."

brown and refined cane-sugar in the United States, &c.—Continued..

Value of foreign sugar consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Lbs.*
2, 574, 081	6, 797, 785	132, 825, 000	11, 511, 556	101, 993, 719	121, 313, 444	223, 307, 163	17, 070, 240	
4, 385, 281	12, 336, 055	101, 442, 000	13, 747, 948	172, 450, 615	87, 694, 052	260, 144, 667	17, 563, 990	
4, 168, 862	9, 942, 030	104, 940, 000	3, 596, 879	160, 965, 852	101, 343, 121	262, 308, 973	18, 065, 813	
1, 794, 785	4, 233, 848	163, 240, 000	667, 447	69, 444, 470	162, 572, 553	232, 017, 023	18, 603, 956	
4, 572, 705	11, 456, 815	119, 003, 436	1, 858, 225	182, 329, 492	117, 145, 211	299, 474, 703	19, 102, 946	
2, 573, 229	6, 636, 269	233, 200, 000	2, 193, 977	101, 865, 203	231, 006, 023	332, 871, 226	19, 640, 029	17. 08
2, 687, 068	7, 011, 254	210, 876, 000	4, 237, 807	107, 458, 852	206, 638, 193	314, 097, 045	20, 225, 760	
3, 165, 433	12, 571, 686	163, 240, 000	1, 927, 472	228, 573, 926	161, 312, 528	389, 886, 454	20, 869, 760	
2, 632, 465	11, 407, 348	279, 840, 000	3, 513, 779	244, 008, 984	276, 326, 221	520, 335, 205	21, 609, 554	
2, 182, 734	9, 458, 514	259, 200, 000	2, 356, 104	242, 169, 247	256, 843, 896	499, 013, 143	22, 358, 293	
2, 085, 214	9, 035, 930	294, 532, 524	3, 244, 861	204, 272, 283	291, 287, 663	495, 559, 946	23, 191, 876	
4, 043, 613	17, 522, 322	250, 906, 788	3, 251, 369	374, 014, 916	247, 655, 419	621, 670, 335	23, 974, 993	
4, 175, 757	18, 094, 953	281, 017, 836	2, 498, 390	447, 937, 734	278, 519, 446	726, 457, 180	24, 843, 547	
4, 178, 789	18, 108, 084	382, 457, 592	5, 827, 331	445, 418, 963	376, 630, 261	822, 049, 224	25, 721, 956	
3, 439, 400	15, 904, 066	523, 911, 784	9, 893, 751	403, 873, 864	514, 018, 033	917, 891, 897	26, 615, 328	
3, 994, 414	17, 309, 127	404, 176, 410	11, 160, 945	440, 041, 631	393, 015, 465	833, 057, 096	27, 586, 113	29. 03
6, 410, 921	27, 780, 657	269, 843, 882	9, 271, 191	521, 836, 957	260, 572, 691	782, 409, 648	28, 349, 746	
12, 519, 003	54, 249, 014	87, 405, 480	5, 338, 247	762, 137, 041	82, 067, 233	844, 204, 274	29, 124, 515	
4, 579, 742	23, 662, 002	333, 539, 269	7, 201, 090	444, 554, 984	326, 338, 179	770, 893, 163	29, 966, 042	
6, 880, 642	35, 549, 985	427, 962, 150	6, 558, 757	621, 982, 810	421, 403, 393	1, 043, 386, 203	30, 685, 586	
7, 029, 252	36, 317, 800	262, 048, 500	4, 466, 031	660, 741, 053	257, 582, 469	918, 323, 522	31, 443, 321	
10, 008, 075	37, 253, 938	270, 214, 455	6, 511, 134	729, 810, 185	263, 703, 321	993, 513, 506	32, 238, 403	
10, 724, 455	29, 773, 870	551, 843, 292	2, 755, 252	533, 587, 664	549, 088, 040	1, 082, 675, 704	32, 987, 985	
10, 221, 432	27, 799, 177	240, 240, 000	3, 595, 009	502, 441, 014	236, 644, 991	739, 086, 005	33, 211, 430	
12, 317, 327	39, 385, 624	87, 860, 344	2, 328, 483	605, 944, 651	85, 531, 861	691, 476, 512	33, 345, 224	
18, 969, 914	42, 665, 462	11, 882, 728	1, 900, 002	614, 040, 361	9, 982, 726	624, 023, 087	33, 394, 882	26. 96
30, 518, 894	70, 556, 898	20, 672, 080	4, 460, 138	987, 009, 994	16, 211, 842	1, 003, 221, 836	34, 324, 665	
[5] 28, 497, 998	66, 888, 328	46, 904, 000	8, 130, 175	[5] 936, 786, 240	38, 773, 825	975, 560, 065	35, 342, 849	
30, 359, 883	73, 667, 652	43, 068, 168	2, 218, 150	997, 298, 331	40, 850, 018	1, 038, 148, 349	36, 361, 669	
30, 645, 236	78, 506, 932	99, 803, 786	3, 167, 523	1, 007, 625, 757	96, 636, 263	1, 104, 262, 020	37, 400, 130	
35, 986, 347	95, 007, 935	104, 425, 593	4, 427, 576	1, 183, 089, 145	99, 998, 017	1, 283, 087, 162	38, 558, 371	
29, 690, 521	88, 073, 460	177, 322, 521	3, 841, 078	1, 166, 394, 287	173, 481, 443	1, 339, 875, 730	39, 723, 755	
27, 876, 769	101, 195, 068	154, 251, 431	4, 478, 492	1, 346, 942, 551	149, 772, 939	1, 496, 715, 490	40, 967, 095	
28, 226, 309	103, 219, 382	131, 613, 817	10, 083, 363	1, 378, 498, 832	121, 530, 454	1, 500, 029, 286	42, 265, 762	
30, 492, 526	106, 572, 229	108, 403, 174	15, 432, 622	1, 511, 456, 916	92, 970, 552	1, 604, 427, 468	43, 456, 931	35. 64
33, 380, 643	102, 672, 653	141, 229, 925	35, 449, 423	1, 575, 893, 945	105, 780, 502	1, 681, 674, 447	44, 588, 083	
37, 625, 063	101, 485, 776	171, 588, 973	51, 863, 691	1, 561, 880, 545	119, 725, 282	1, 681, 605, 827	45, 687, 668	
34, 337, 351	106, 186, 440	200, 206, 198	53, 763, 854	1, 455, 387, 854	146, 442, 344	1, 601, 830, 198	46, 761, 551	
....	....	....	....	....	....	....	47, 874, 485	

[4] These statistics are from October 1, 1842, to June 30, 1843, nine months.
[5] The values paid for customs and foreign sugar consumed are quoted from the consumption tables in the Annual Reports of the Bureau of Statistics.

TABLE VIII.—*Imports, exports, cost, production, and consumption of cane, maple, and sor-*

Years.	Foreign.			Value of foreign sugar consumed.			
	Imports.	Exports.	Difference.	Price.	Value.	Duty.	Paid for customs.
FIRST DECENNIUM.	*Pounds.*	*Pounds.*	*Pounds.*		*Dollars.*		*Dollars.*
1790	18, 229, 419	49, 787	18, 179, 632	......	(3)	......	185, 649
1791	24, 901, 639	75, 661	24, 825, 978	......	......	......	383, 234
1792	[1]24, 420, 372	1, 197, 916	23, 222, 456	......	......	......	355, 969
1793	[1]47, 762, 505	4, 611, 988	43, 150, 517	......	......	......	688, 812
1794	[1]48, 705, 900	20, 762, 221	27, 943, 679	......	......	......	469, 847
1795	63, 783, 405	22, 117, 267	41, 666, 138	......	......	......	651, 101
1796	59, 469, 154	35, 832, 790	23, 636, 364	......	......	......	355, 789
1797	72, 765, 821	38, 570, 051	34, 195, 770	......	......	......	589, 567
1798	87, 523, 918	51, 740, 717	35, 783, 201	......	......	......	641, 247
1799	103, 846, 468	79, 054, 040	24, 792, 428	......	......	......	3, 026, 964
SECOND DECENNIUM.							
1800	113, 339, 751	56, 557, 455	56, 782, 296	......	......	......	1, 272, 833
1801	136, 628, 936	97, 734, 211	38, 894, 725	......	......	......	978, 401
1802	98, 630, 775	61, 180, 288	37, 450, 487	......	......	......	689, 446
1803	73, 822, 203	23, 226, 453	50, 595, 750	......	......	......	1, 235, 077
1804	128, 722, 669	74, 172, 220	54, 550, 449	......	......	......	1, 573, 714
1805	186, 471, 773	122, 808, 993	63, 662, 780	......	......	......	1, 544, 023
1806	199, 133, 437	145, 630, 841	53, 502, 596	......	......	......	1, 396, 316
1807	220, 669, 099	143, 119, 605	77, 549, 494	......	7, 929, 772	......	1, 993, 139
1808	104, 411, 777	28, 962, 527	75, 459, 250	......	......	......	1, 763, 008
1809	76, 753, 394	45, 297, 338	31, 456, 056	......	......	......	752, 126
THIRD DECENNIUM.							
1810	55, 104, 722	47, 024, 002	8, 080, 720	......	......	......	410, 452
1811	77, 200, 594	18, 268, 347	58, 932, 247	......	......	......	1, 502, 465
1812	83, 409, 956	13, 927, 277	69, 482, 679	......	......	......	1, 765, 403
1813	33, 397, 038	6, 617, 288	26, 779, 750	......	......	......	1, 364, 527
1814	29, 464, 943	762	29, 464, 181	......	......	......	1, 503, 279
1815	45, 043, 162	3, 188, 718	41, 854, 444	......	6, 913, 370	......	2, 130, 779
1816	55, 110, 381	17, 723, 967	37, 386, 414	......	......	......	1, 911, 861
1817	93, 147, 368	20, 195, 168	72, 852, 200	......	......	......	2, 225, 944
1818	68, 358, 936	22, 057, 904	46, 301, 032	......	......	......	1, 415, 565
1819	73, 944, 657	11, 267, 182	62, 677, 475	......	......	......	1, 911, 250
FOURTH DECENNIUM.							
1820	[2]66, 730, 179	31, 389, 109	35, 341, 070	......	......	......	1, 076, 982
1821	59, 515, 701	20, 061, 725	39, 453, 976	......	......	......	1, 202, 360
1822	88, 310, 686	14, 446, 860	73, 863, 826	......	......	......	2, 268, 782
1823	60, 791, 470	21, 459, 024	39, 332, 446	......	1, 779, 881	......	1, 189, 907
1824	94, 452, 057	14, 128, 429	80, 323, 628	......	4, 171, 756	......	2, 500, 127
825	71, 772, 468	21, 836, 771	49, 935, 697	......	2, 617, 965	......	1, 507, 043
1826	84, 935, 959	21, 146, 856	63, 789, 103	......	3, 569, 920	......	1, 961, 327
1827	76, 702, 280	15, 343, 530	61, 358, 750	......	3, 385, 958	......	1, 872, 943
1828	56, 936, 418	10, 691, 088	46, 245, 330	......	2, 718, 296	......	1, 422, 184
1829	63, 308, 621	12, 343, 478	50, 965, 143	......	2, 807, 599	......	1, 559, 174
FIFTH DECENNIUM.							
1830	86, 490, 113	9, 725, 342	76, 764, 771	......	3, 946, 547	......	2, 352, 155
1831	109, 231, 168	22, 580, 947	86, 650, 221	......	3, 639, 488	......	2, 669, 860
1832	66, 488, 891	17, 536.028	48, 952, 863	......	2, 001, 303	......	1, 498, 399
1833	97, 734, 438	6, 619, 154	91, 115, 284	......	4, 329, 474	......	2, 328, 990
1834	115, 392, 096	13, 969, 203	101, 422, 893	......	4, 703, 312	......	2, 575, 155
1835	126, 038, 333	7, 257, 476	118, 780, 857	......	6, 243, 350	......	3, 053, 723
1836	191, 428, 305	34, 492, 282	156, 938, 023	......	9, 681, 940	......	3, 948, 104
1837	136, 149, 761	41, 124, 819	95, 024, 942	......	4, 546, 128	......	2, 390, 031
1838	153, 883, 863	11, 624, 324	142, 259, 539	......	6, 697, 656	......	3, 617, 377
1839	195, 289, 024	13, 154, 653	182, 134, 371	......	8, 939, 000	......	4, 593, 141

ghum sugar, candy, and melado in the United States for each fiscal year from 1790 *to* 1878.

Value of foreign sugar consumed.	Domestic.		Consumption.				Average consumption per capita.
Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Pounds.*
....	12,000,000	....	18,179,632	12,000,000	30,179,632	3,929,214	
....	13,000,000	....	24,825,978	13,000,000	37,825,978	4,049,247	
....	11,200,000	....	23,222,456	11,200,000	34,422,456	4,172,945	
....	14,215,000	....	43,150,517	14,215,000	57,365,517	4,300,425	
....	16,240,000	....	27,943,679	16,240,000	44,183,679	4,431,802	9.65
....	13,290,000	....	41,583,263	13,290,000	54,873,263	4,567,292	
....	15,340,000	....	23,719,239	15,340,000	39,059,239	4,706,926	
....	12,400,000	....	34,195,770	12,400,000	46,595,770	4,850,718	
....	14,499,500	....	26,936,602	14,499,500	41,436,102	4,998,706	
....	16,600,000	....	33,639,027	16,600,000	50,239,027	5,151,117	
....	16,000,000	....	56,146,185	16,000,000	72,146,185	5,308,483	
....	20,000,000	....	39,530,836	20,000,000	59,530,836	5,475,385	
....	21,000,000	....	30,245,015	21,000,000	51,245,015	5,647,854	
....	20,200,000	97,029	49,403,084	20,102,971	69,506,055	5,825,758	
....	22,499,500	924,181	62,948,587	21,575,319	84,523,906	6,009,469	12.64
....	25,299,500	390,445	61,312,733	24,909,055	86,221,788	6,198,858	
....	28,000,000	510,578	55,852,643	27,489,422	83,342,065	6,394,211	
9,992,911	28,000,000	139,986	77,549,494	27,860,014	105,409,508	6,595,718	
....	31,000,000	20,362	68,482,885	30,979,638	99,462,523	6,803,567	
....	34,000,000	287,921	30,085,070	33,712,079	63,797,149	7,018,007	
....	39,000,000	762,321	16,418,071	38,237,679	54,655,750	7,239,881	
....	38,603,070	244,242	58,932,247	38,358,828	97,291,075	7,449,832	
....	41,000,000	142,690	69,482,679	40,857,310	110,339,989	7,665,973	
....	42,500,000	732,320	26,779,750	41,767,680	68,547,430	7,888,280	
....	45,000,000	756	29,464,181	44,999,244	74,463,425	8,117,036	10.86
9,044,149	43,000,000	16,692	41,854,444	42,983,308	84,837,752	8,352,429	
....	46,000,000	79,577	37,386,414	45,920,423	83,306,837	8,595,645	
....	45,000,000	180,863	72,852,200	44,819,137	117,671,337	8,845,887	
....	47,500,000	111,894	46,301,032	47,388,106	93,689,138	9,103,354	
....	50,000,000	80,055	62,677,475	49,919,945	112,597,420	9,365,460	
....	51,000,000	80,836	35,341,070	50,919,164	86,260,234	9,638,453	
....	55,000,000	181,119	39,453,976	54,818,881	94,272,857	9,917,091	
....	58,000,000	185,658	73,863,826	57,814,342	131,678,168	10,205,555	
2,969,788	57,650,000	59,033	39,332,446	57,590,967	96,923,413	10,504,195	
6,671,883	63,960,000	63,868	80,323,628	63,896,132	144,219,760	10,813,777	11.91
4,125,008	63,650,000	77,799	49,935,697	63,572,201	113,507,898	11,132,991	
5,531,247	84,975,000	226,016	63,789,103	84,748,984	148,538,087	11,459,903	
5,258,901	117,005,000	255,447	61,358,750	116,749,553	178,108,303	11,803,775	
4,140,480	132,599,575	323,326	46,245,330	132,276,249	178,521,579	12,157,956	
4,366,773	90,014,890	532,996	50,965,143	89,481,894	140,447,037	12,508,898	
6,298,702	119,315,000	1,623,866	76,764,771	117,691,134	194,455,905	12,866,020	
6,309,348	123,625,000	2,237,619	86,650,221	121,387,381	208,037,602	13,205,429	
3,499,702	121,125,000	856,022	48,952,863	120,268,978	169,221,841	13,615,826	
6,658,464	116,850,000	517,076	91,115,284	116,332,924	207,448,208	14,019,343	
7,278,467	121,625,000	2,463,841	101,422,893	119,161,159	220,584,052	14,420,731	15.40
9,297,073	152,500,000	870,506	118,780,857	151,629,494	270,410,351	14,814,243	
13,630,044	72,150,000	1,571,108	156,936,023	70,578,892	227,514,915	15,270,483	
6,936,159	120,850,000	2,150,769	95,024,942	118,699,231	213,724,173	15,711,264	
10,315,033	113,075,000	3,019,451	142,259,539	110,055,549	252,315,088	16,120,891	
13,532,141	117,850,000	5,169,926	182,134,371	112,680,074	294,814,445	16,599,492	

TABLE VIII.—*Imports, exports, cost, production, and consumption*

Years.	Foreign.			Value of foreign sugar consumed.			
	Imports.	Exports.	Difference.	Price.	Value.	Duty.	Paid for customs.
SIXTH DECENNIUM.							
1840	120, 941, 277	18, 947, 018	101, 993, 719	......	4, 223, 754	......	2, 574, 145
1841	184, 264, 995	11, 814, 266	172, 450, 615	......	7, 950, 808	......	4, 385, 295
1842	173, 864, 844	12, 897, 703	160, 965, 852	......	5, 773, 297	......	4, 169, 017
1843	[4]71, 339, 050	1, 886, 976	69, 444, 470	......	2, 439, 402	......	1, 795, 020
1844	186, 808, 695	4, 475, 032	182, 329, 492	......	6, 884, 501	......	4, 572, 952
1845	115, 666, 656	13, 799, 637	101, 865, 203	......	4, 063, 202	......	2, 573, 331
1846	128, 032, 840	20, 570, 023	107, 458, 852	......	4, 324, 562	......	2, 687, 142
1847	236, 970, 894	8, 394, 918	228, 573, 926	......	9, 406, 444	......	3, 165, 490
1848	257, 144, 861	13, 120, 769	244, 008, 984	......	8, 775, 772	......	2, 632, 732
1849	259, 326, 534	17, 149, 994	242, 169, 247	......	7, 276, 241	......	2, 182, 872
SEVENTH DECENNIUM							
	Pounds.	*Pounds.*	*Pounds.*		*Dollars.*		*Dollars.*
1850	218, 439, 055	14, 153, 065	204, 272, 283	......	6, 953, 667	......	2, 086, 099
1851	380, 423, 569	6, 387, 108	374, 014, 916	......	13, 483, 178	......	4, 044, 954
1852	457, 544, 544	9, 573, 357	447, 937, 734	......	13, 924, 707	......	4, 177, 410
1853	464, 427, 281	18, 981, 701	445, 418, 963	......	13, 934, 467	......	4, 180, 341
1854	455, 964, 452	52, 019, 584	403, 894, 136	......	12, 467, 108	......	3, 440, 133
1855	473, 884, 218	33, 716, 323	440, 114, 752	......	13, 323, 505	......	3, 997, 052
1856	545, 262, 754	23, 341, 474	521, 872, 706	......	21, 373, 859	......	6, 412, 158
1857	777, 003, 115	14, 731, 801	762, 137, 041	......	41, 731, 898	......	12, 519, 569
1858	519, 240, 945	74, 910, 624	444, 330, 321	......	19, 083, 918	......	4, 580, 140
1859	655, 868, 415	33, 608, 653	622, 003, 778	......	28, 670, 426	......	6, 880, 902
EIGHTH DECENNIUM.							
1860	694, 879, 795	34, 016, 070	660, 777, 373	......	29, 291, 087	......	7, 029, 861
1861	809, 813, 489	80, 408, 714	729, 404, 775	......	27, 254, 957	......	10, 011, 932
1862	557, 143, 184	23, 552, 145	533, 591, 039	......	19, 049, 781	......	10, 724, 725
1863	522, 131, 247	16, 155, 557	502, 448, 466	......	17, 642, 237	......	10, 272, 961
1864	632, 248, 612	27, 271, 713	605, 949, 979	......	27, 069, 139	......	12, 317, 647
1865	651, 971, 882	30, 743, 484	614, 067, 543	......	23, 696, 358	......	18, 972, 632
1866	1, 000, 076, 709	8, 580, 092	991, 496, 617	......	40, 182, 049	......	30, 633, 113
1867	849, 108, 911	12, 210, 707	835, 416, 841	......	[5]38, 513, 055	......	[5]28, 589, 781
1868	1, 121, 221, 670	16, 112, 818	1, 105, 108, 852	......	43, 434, 090	......	30, 455, 442
1869	1, 247, 885, 371	17, 828, 678	1, 230, 056, 693	......	48, 258, 660	......	30, 929, 337
NINTH DECENNIUM.							
1870	1, 196, 829, 389	18, 333, 902	1, 178, 495, 487	......	60, 270, 688	......	36, 829, 037
1871	1, 277, 525, 009	10, 364, 161	1, 267, 160, 848	......	60, 849, 370	......	30, 758, 657
1872	1, 509, 249, 507	12, 122, 280	1, 497, 127, 227	......	76, 029, 865	......	28, 876, 131
1873	1, 568, 393, 877	23, 930, 453	1, 544, 463, 424	......	79, 513, 278	......	29, 842, 942
1874	1, 701, 354, 312	19, 310, 777	1, 682, 043, 535	......	81, 491, 851	......	32, 499, 835
1875	1, 797, 586, 806	11, 200, 857	1, 786, 385, 949	......	71, 800, 598	......	34, 662, 057
1876	1, 494, 065, 427	15, 870, 600	1, 478, 194, 827	......	67, 030, 351	......	39, 450, 917
1877	1, 623, 973, 537	3, 122, 956	1, 620, 850, 581	......	73, 780, 829	......	35, 274, 468
1878	....	....	....	......	....	......	....

[1] These imports are for calendar years and not fiscal years.
[2] Estimated by taking the mean between 1819 and 1821, there being no statistics of imports on record.
[3] The only reliable values on record from 1790 to 1823 are those of 1807 and 1815, which are found in "Pitkin's Commerce of the United States."

of cane, maple, and sorghum sugar, candy, and melado, &c.—Continued.

Value of foreign sugar consumed.	Domestic.		Consumption.				Average consumption per capita.
Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Pounds.*
6, 797, 899	167, 930, 705	11, 511, 556	101, 993, 719	156, 419, 149	258, 412, 868	17, 070, 240	
12, 336, 103	135, 442, 000	13, 747, 948	172, 450, 615	121, 694, 052	294, 144, 667	17, 563, 990	
9, 942, 314	142, 277, 795	3, 596, 879	160, 965, 852	138, 680, 916	299, 646, 768	18, 065, 813	
4, 234, 422	200, 240, 000	667, 447	69, 444, 470	199, 572, 553	269, 017, 023	18, 603, 956	
11, 457, 453	137, 003, 436	1, 858, 225	182, 329, 492	135, 145, 211	317, 474, 703	19, 102, 946	
6, 636, 533	273, 979, 000	2, 193, 977	101, 865, 203	271, 785, 023	373, 650, 226	19, 640, 029	18. 73
7, 011, 704	235, 371, 625	4, 237, 807	107, 458, 852	231, 133, 818	338, 592, 670	20, 225, 760	
12, 571, 934	192, 002, 000	1, 927, 472	228, 573, 926	190, 074, 528	418, 648, 454	20, 869, 760	
11, 408, 504	312, 510, 570	3, 513, 779	244, 008, 984	308, 996, 791	553, 005, 775	21, 609, 554	
9, 459, 113	292, 772, 000	2, 356, 104	242, 169, 247	290, 415, 896	532, 585, 143	22, 358, 293	
9, 039, 766	328, 785, 960	3, 244, 861	204, 272, 283	325, 541, 099	529, 813, 382	23, 191, 876	
17, 528, 132	283, 048, 788	3, 251, 369	374, 014, 916	279, 797, 419	653, 812, 335	23, 974, 993	
18, 102, 117	310, 517, 836	2, 498, 390	447, 937, 734	308, 019, 446	755, 957, 180	24, 843, 547	
18, 114, 808	409, 457, 592	5, 827, 331	445, 418, 963	403, 630, 261	849, 049, 224	25, 721, 956	
15, 907, 241	549, 283, 584	9, 893, 751	403, 894, 136	539, 389, 833	943, 283, 969	26, 615, 328	
17, 320, 557	426, 387, 582	11, 160, 945	440, 114, 752	415, 226, 637	855, 341, 389	27, 586, 113	30. 18
27, 786, 017	295, 843, 882	9, 271, 191	521, 872, 706	286, 572, 691	808, 445, 397	28, 349, 746	
54, 251, 467	114, 405, 480	5, 338, 247	762, 137, 041	109, 067, 233	871, 204, 274	29, 124, 515	
23, 664, 058	366, 540, 144	7, 201, 090	444, 330, 321	359, 339, 054	803, 669, 375	29, 966, 042	
35, 551, 328	465, 972, 150	6, 558, 757	622, 003, 778	459, 413, 393	1, 081, 417, 171	30, 685, 586	
36, 320, 948	302, 209, 105	4, 466, 031	660, 777, 673	297, 743, 074	958, 520, 447	31, 443, 321	
37, 266, 889	312, 294, 955	6, 511, 134	729, 404, 775	305, 783, 821	1, 035, 188, 596	32, 238, 403	
29, 774, 506	595, 980, 722	2, 755, 252	533, 591, 039	593, 225, 470	1, 126, 816, 509	32, 987, 985	
27, 915, 198	281, 923, 795	3, 595, 009	502, 448, 466	278, 328, 786	780, 777, 252	33, 211, 430	
39, 386, 786	128, 568, 644	2, 328, 483	605, 949, 979	126, 240, 161	732, 190, 140	33, 345, 224	
42, 668, 990	51, 903, 854	2, 132, 147	614, 067, 543	49, 771, 707	663, 839, 250	33, 394, 882	28. 16
70, 820, 142	58, 715, 645	4, 460, 138	991, 496, 617	54, 255, 507	1, 045, 752, 124	34, 324, 665	
67, 102, 836	82, 698, 658	8, 197, 550	[5]939, 866, 458	74, 501, 108	1, 014, 307, 566	35, 342, 849	
73, 889, 532	76, 689, 844	2, 282, 655	1, 000, 886, 403	74, 407, 189	1, 075, 293, 593	36, 361, 669	
79, 187, 997	129, 142, 286	3, 187, 993	1, 018, 807, 068	125, 954, 293	1, 144, 761, 361	37, 400, 130	
97, 099, 725	132, 979, 178	4, 501, 221	1, 216, 459, 872	128, 477, 957	1, 344, 937, 829	38, 558, 371	
91, 608, 027	208, 196, 046	3, 945, 923	1, 231, 883, 061	204, 250, 123	1, 436, 133, 184	39, 723, 755	
104, 905, 996	186, 106, 426	4, 590, 932	1, 412, 919, 438	181, 515, 494	1, 594, 434, 932	40, 967, 095	
109, 356, 220	163, 955, 047	10, 222, 728	1, 485, 657, 191	153, 732, 319	1, 639, 389, 510	42, 265, 762	
113, 991, 686	141, 629, 424	15, 585, 587	1, 644, 765, 505	126, 043, 837	1, 770, 809, 342	43, 456, 931	38. 29
106, 462, 655	184, 536, 695	35, 694, 888	1, 649, 100, 179	148, 841, 807	1, 797, 941, 986	44, 588, 083	
106, 481, 268	214, 974, 473	52, 024, 916	1, 658, 719, 324	162, 949, 557	1, 821, 668, 881	45, 687, 668	
109, 055, 297	241, 286, 958	54, 073, 314	1, 505, 086, 114	187, 213, 644	1, 692, 299, 758	46, 761, 551	
....	....	....	....	....	....	47, 874, 485	

[4] These statistics are from October 1, 1842, to June 30, 1843, nine months.
[5] The "Values" "Paid for Customs" and foreign sugar consumed are quoted from the consumption tables in the Annual Reports of the Bureau of Statistics.

TABLE IX.—*Imports, exports, cost, production, and consumption of*

Years.	Foreign.			Value of cane molasses consumed.		
	Imports.	Exports.	Difference.	Price per gallon.	Value.	Rate of duty.
FIRST DECENNIUM.	*Gallons.*	*Gallons.*	*Gallons.*	*Cents.*	*Dollars.*	*Cents.*
1790	5,992,646	15,537	5,977,109	....	....	.025
1791	7,194,606	12,721	7,181,885	(3).199	1,439,195	.030
1792	(1)5,229,915	11,338	5,218,577	....	....	.030
1793	(1)4,930,141	28,733	4,901,408	....	....	.030
1794	(1)3,476,906	7,216	3,469,690	....	....	.030
1795	4,425,621	20,124	4,405,497	....	....	.030
1796	4,965,191	112,257	1,852,934	....	....	.030
1797	3,876,420	48,559	3,827,861	....	....	.040
1798	4,629,370	32,350	4,597,020	....	....	.040
1799	4,100,242	61,911	4,038,331	....	....	.040
SECOND DECENNIUM.						
1800	4,092,677	39,122	4,053,555	....	....	.040
1801	5,717,290	421,628	5,295,662	....	....	.040
1802	6,833,261	56,959	6,776,302	(3).299	2,026,114	.040
1803	6,725,400	38,552	6,686,848	(3).298	1,992,681	.040
1804	5,747,256	55,259	5,691,997	(3).299	1,702,907	.040
1805	9,021,700	48,474	8,973,226	....	....	.050
1806	8,597,456	53,798	8,543,658	....	....	.050
1807	8,511,234	40,957	8,470,277	(4).369	3,125,532	.050
1808	6,489,008	7,337	6,481,671	....	....	.050
1809	5,219,415	33,943	5,185,472	....	....	.050
THIRD DECENNIUM.						
1810	8,055,629	40,245	8,015,384	....	....	.050
1811	8,634,418	18,837	8,615,581	....	....	.050
1812	8,141,264	8,001	8,133,263	....	....	.050
1813	3,199,361	1,309	3,198,052	....	....	.100
1814	3,376,367	....	3,376,367	....	....	.100
1815	4,752,642	11,228	4,741,414	....	....	.100
1816	8,494,248	29,008	8,465,240	....	....	.100
1817	11,480,948	14,457	11,466,491	....	....	.050
1818	12,353,985	11,478	12,342,507	....	....	.050
1819	10,583,298	20,486	10,562,812	....	....	.050
FOURTH DECENNIUM.						
1820	(2)9,835,140	82,571	9,752,569	....	....	.050
1821	9,086,982	39,421	9,047,561	.188	1,707,995	.050
1822	11,990,569	13,292	11,977,277	.199	2,393,945	.050
1823	13,019,328	3,409	13,015,919	.202	2,633,228	.050
1824	13,117,724	18,737	13,098,987	.183	2,408,911	.050
1825	12,535,062	15,806	12,519,256	.203	2,543,137	.050
1826	13,843,045	50,602	13,792,443	.204	2,822,309	.050
1827	13,376,502	20,107	13,356,395	.210	2,812,490	.050
1828	13,393,651	30,168	13,363,483	.207	2,778,983	.050
1829	10,150,224	36,920	10,113,304	.145	1,475,609	.100
FIFTH DECENNIUM.						
1830	8,374,139	27,121	8,347,018	.118	988,985	.100
1831	17,085,878	17,695	17,068,183	.142	2,427,708	.050
1832	15,860,553	29,656	15,830,897	.158	2,515,498	.050
1833	15,693,050	18,730	15,674,320	.182	2,862,536	.050
1834	17,086,472	58,736	17,027,736	.174	2,975,223	.050
1835	18,971,603	50,776	18,920,827	.161	3,062,045	.050
1836	18,051,784	42,951	18,008,833	.225	4,061,240	.050
1837	16,451,182	90,597	16,360,585	.208	3,411,757	.050
1838	21,196,411	62,098	21,134,313	.181	3,845,701	.050
1839	23,094,677	121,171	22,973,506	.188	4,327,500	.050

cane molasses in the United States for each fiscal year from 1790 *to* 1878.

Value of cane molasses consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Number.*	*Galls.*
149, 428	....	....	....	5, 977, 109	....	5, 977, 109	3, 929, 214	
215, 457	1, 644, 651	....	....	7, 181, 885	....	7, 181, 885	4, 049, 247	
156, 557	....	18, 181	....	5, 218, 577	18, 181	5, 236, 758	4, 172, 945	
147, 042	....	19, 545	....	4, 901, 408	19, 545	4, 920, 953	4, 300, 425	
104, 091	....	21, 818	....	3, 469, 690	21, 818	3, 491, 508	4, 431, 802	
132, 165	....	26, 363	....	4, 405, 497	26, 363	4, 431, 860	4, 567, 292	1. 07
145, 588	....	30, 909	....	4, 852, 934	30, 909	4, 883, 843	4, 706, 926	
153, 114	....	36, 363	....	3, 827, 861	36, 363	3, 864, 224	4, 850, 718	
183, 881	....	45, 409	....	4, 597, 020	45, 409	4, 642, 429	4, 998, 706	
161, 533	....	54, 545	....	4, 038, 331	54, 545	4, 092, 876	5, 151, 117	
162, 142	....	90, 909	....	4, 053, 555	90, 909	4, 144, 464	5, 308, 483	
211, 826	....	272, 727	....	5, 295, 662	272, 727	5, 568, 389	5, 475, 385	
271, 652	2, 297, 166	454, 545	....	6, 776, 302	454, 545	7, 230, 847	5, 647, 854	
267, 474	2, 260, 154	563, 636	....	6, 686, 848	563, 636	7, 250, 484	5, 825, 758	
227, 680	1, 930, 586	681, 772	....	5, 691, 997	681, 772	6, 373, 769	6, 009, 469	
448, 661	....	754, 500	....	8, 973, 226	754, 500	9, 727, 726	6, 198, 858	1. 19
427, 183	....	818, 181	....	8, 543, 658	818, 181	9, 361, 839	6, 394, 211	
423, 514	3, 549, 046	909, 090	....	8, 470, 277	909, 090	9, 379, 367	6, 595, 718	
324, 084	....	1, 272, 727	....	6, 481, 671	1, 272, 727	7, 754, 398	6, 803, 567	
259, 274	....	1, 363, 636	....	5, 185, 472	1, 363, 636	6, 549, 108	7, 018, 007	
400, 769	....	1, 333, 333	....	8, 015, 384	1, 333, 353	9, 348, 717	7, 239, 881	
430, 779	....	1, 500, 000	....	8, 615, 581	1, 500, 000	10, 115, 581	7, 449, 832	
406, 663	....	1, 583, 333	....	8, 133, 263	1, 583, 333	9, 716, 596	7, 665, 973	
319, 805	....	1, 666, 666	....	3, 198, 052	1, 666, 666	4, 864, 718	7, 888, 280	
337, 637	....	1, 750, 000	....	3, 376, 367	1, 750, 000	5, 126, 367	8, 117, 036	
474, 141	....	1, 833, 333	....	4, 741, 414	1, 833, 333	6, 574, 747	8, 352, 429	1. 16
846, 524	....	1, 916, 666	....	8, 465, 240	1, 916, 666	10, 381, 906	8, 595, 645	
573, 325	....	2, 000, 000	....	11, 466, 491	2, 000, 000	13, 466, 491	8, 845, 887	
617, 125	....	2, 041, 666	....	12, 342, 507	2, 041, 666	14, 384, 173	9, 103, 354	
528, 141	....	2 093, 333	....	10, 562, 812	2, 093, 333	12, 656, 145	9, 365, 460	
487, 628	....	2, 250, 000	....	9, 752, 569	2, 250, 000	12, 002, 569	9, 638, 453	
452, 378	2, 160, 373	2, 416, 666	....	9, 047, 561	2, 416, 666	11, 464, 227	9, 917, 091	
598, 864	2, 992, 809	2, 500, 000	....	11, 977, 277	2, 500, 000	14, 477, 277	10, 205, 555	
650, 796	3, 284, 024	2, 887, 500	....	13, 015, 919	2, 887, 500	15, 903, 419	10, 504, 195	
654, 949	3, 063, 860	3, 080, 000	....	13, 098, 987	3, 080, 000	16, 178, 987	10, 813, 777	
625, 963	3, 169, 100	2, 887, 500	....	12, 519, 256	2, 887, 500	15, 406, 756	11, 132, 991	1. 45
689, 622	3, 511, 931	4, 331, 250	[5]2, 070	13, 792, 443	4, 329, 180	18, 121, 623	11, 459, 903	
667, 820	3, 480, 309	6, 833, 750	5, 037	13, 356, 395	6, 828, 713	20, 185, 108	11, 803, 775	
668, 174	3, 447, 157	8, 466, 631	2, 003	13, 363, 483	8, 464, 628	21, 828, 111	12, 157, 956	
1, 011, 330	2, 486, 939	4, 642, 907	6, 640	10, 113, 304	4, 636, 267	14, 749, 571	12, 508, 898	
834, 702	1, 823, 687	6, 485, 769	13, 227	8, 347, 018	6, 472, 542	14, 819, 560	12, 866, 020	
853, 409	3, 281, 117	6, 663, 461	3, 160	17, 068, 183	6, 660, 301	23, 728, 484	13, 205, 429	
791, 545	3, 307, 043	6, 663, 461	8, 310	15, 830, 897	6, 655, 151	22, 486, 048	13, 615, 826	
783, 716	3, 646, 252	6, 219, 230	7, 597	15, 674, 320	6, 211, 633	21, 885, 953	14, 019, 343	
851, 387	3, 826, 610	6, 663, 461	19, 780	17, 027, 736	6, 643, 681	23, 671, 417	14, 420, 731	
946, 041	4, 008, 086	8, 884, 615	6, 543	18, 920, 827	8, 878, 072	27, 798, 899	14, 814, 243	1. 59
900, 442	4, 961, 682	2, 665, 384	2, 837	18, 008, 833	2, 662, 547	20, 671, 380	15, 270, 483	
818, 029	4, 229, 786	6, 219, 230	23, 903	16, 360, 585	6, 195, 327	22, 555, 912	15, 711, 264	
1, 056, 716	4, 902, 417	5, 775, 000	22, 067	21, 134, 313	5, 752, 933	26, 887, 246	16, 120, 891	
1, 148, 675	5, 476, 175	6, 219, 230	11, 460	22, 973, 506	6, 207, 770	29, 181, 276	16, 599, 492	

TABLE IX.—*Imports, exports, cost, production, and consumption of*

Years.	Foreign.			Value of cane molasses consumed.		
	Imports.	Exports.	Difference.	Price per gallon.	Value.	Rate of duty.
SIXTH DECENNIUM.	*Gallons.*	*Gallons.*	*Gallons.*	*Cents.*	*Dollars.*	*Cents.*
1840	19, 703, 620	188, 078	19, 515, 542	. 146	2, 861, 261	. 050
1841	19, 355, 028	328, 786	19, 026, 242	. 133	2, 542, 933	. 050
1842	17, 834, 927	203, 472	17, 631, 455	. 108	1, 908, 131	. 050
1843	(6)11, 776, 047	100, 763	11, 675, 284	. 095	1, 116, 310	. 045
1844	22, 675, 352	224, 668	22, 450, 684	. 124	2, 795, 555	. 045
1845	18, 301, 033	297, 949	18, 003, 084	. 170	3, 072, 021	. 045
1846	22, 760, 622	414, 678	22, 345, 944	. 145	3, 254, 075	. 045
1847	30, 677, 630	1, 467, 418	29, 210, 212	. 093	2, 740, 392	30 pr. ct.
1848	33, 640, 287	559, 735	33, 080, 552	. 100	3, 337, 865	30 pr. ct.
1849	23, 796, 806	793, 535	23, 003, 271	. 114	2, 636, 920	30 pr. ct.
SEVENTH DECENNIUM.						
1850	25, 044, 835	581, 820	24, 463, 015	. 113	2, 785, 117	30 pr. ct.
1851	36, 376, 772	226, 592	36, 150, 180	. 101	3, 663, 323	30 pr. ct.
1852	32, 795, 610	325, 958	32, 469, 652	. 108	3, 534, 277	30 pr. ct.
1853	31, 886, 100	488, 666	31, 397, 434	. 114	3, 587, 008	30 pr. ct.
1854	27, 759, 463	889, 295	26, 870, 168	. 109	2, 946, 562	30 pr. ct.
1855	26, 385, 593	1, 517, 474	24, 868, 119	. 128	3, 190, 706	30 pr. ct.
1856	23, 617, 674	1, 261, 140	22, 356, 534	. 180	4, 028, 488	30 pr. ct.
1857	32, 705, 844	1, 441, 660	31, 264, 184	. 247	7, 748, 961	30 pr. ct.
1858	24, 566, 357	3, 908, 075	20, 658, 282	. 144	2, 991, 326	24 pr. ct.
1859	32, 818, 146	2, 113, 669	30, 704, 477	. 147	4, 543, 012	24 pr. ct.
EIGHTH DECENNIUM.						
1860	30, 922, 633	1, 222, 118	29, 700, 515	. 166	4, 932, 886	24 pr. ct.
1861	29, 941, 397	3, 068, 986	26, 872, 411	. 130	3, 508, 330	24p.c.&.02
1862	25, 157, 280	1, 296, 564	23, 860, 716	. 134	3, 213, 983	. 050
1863	30, 854, 264	1, 156, 799	29, 697, 465	. 149	4, 439, 597	. 060
1864	33, 571, 230	953, 472	32, 617, 758	. 214	7, 005, 603	. 080
1865	37, 306, 168	1, 487, 815	35, 818, 353	. 194	6, 965, 428	. 080
1866	45, 285, 983	1, 020, 544	44, 265, 439	. 169	7, 495, 864	. 080
1867	56, 123, 079	639, 888	55, 483, 191	. 177	(8)8, 916, 311	. 080
1868	56, 408, 435	548, 428	55, 860, 007	. 216	11, 884, 702	. 080
1869	53, 304, 030	2, 315, 842	50, 988, 188	. 227	11, 847, 827	. 080
NINTH DECENNIUM.						
1870	56, 373, 537	1, 606, 272	54, 767, 265	. 237	11, 345, 631	. 080
1871	44, 401, 359	1, 002, 184	43, 399, 175	. 231	10, 953, 029	. 08 & . 05
1872	45, 214, 403	310, 588	44, 903, 815	. 240	10, 108, 889	. 050
1873	43, 533, 909	558, 289	42, 975, 620	. 236	10, 424, 652	. 050
1874	47, 189, 837	958, 280	46, 231, 557	. 235	11, 122, 174	. 050
1875	49, 112, 255	648, 488	48, 463, 767	. 240	10, 409, 255	.05&25p.c.
1876	39, 026, 200	1, 058, 815	37, 967, 385	. 222	8, 712, 116	.05&25p.c.
1877	30, 188, 963	302, 891	29, 886, 072	. 252	7, 335, 194	.05&25p.c.
1878	....	....	....	....	....	....

[1] These imports are for calendar years and not fiscal years.
[2] Estimated by taking the mean between 1819 and 1821, there being no imports on record for this year.
[3] These prices per gallon are according to the value of the imports; the value of the exports not being considered because none are given.
[4] Quoted from Pitkin's "Commerce of the United States."
[5] From 1826 to 1835, inclusive, the statistics of domestic exports are given in value, which are reduced at the rate of 30 cents per gallon.

cane molasses in the United States for each fiscal year, from 1790 *to* 1878—Continued.

Value of cane molasses consumed.		Domestic.		Consumption.				Average consumption per capita.
Paid for customs.	Total.	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Dollars.	*Dollars.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Number.*	*Galls.*
975, 777	3, 836, 938	10, 217, 307	32, 583	19, 515, 542	10, 184, 724	29, 700, 266	17, 070, 240	
951, 312	3, 494, 245	7, 803, 230	26, 663	19, 026, 242	7, 776, 567	26, 802, 809	17, 563, 990	
881, 573	2, 789, 704	8, 072, 317	63, 467	17, 631, 455	8, 008, 850	25, 640, 305	18, 065, 813	
525, 388	1, 641, 698	12, 556, 923	4, 390	11, 675, 284	12, 552, 533	24, 227, 817	18, 603, 956	
1, 010, 281	3, 805, 836	9, 000, 264	13, 073	22, 450, 684	8, 987, 191	31, 437, 875	19, 102, 946	
810, 139	3, 882, 160	17, 923, 076	69, 237	18, 003, 084	17, 853, 839	35, 856, 923	19, 640, 029	1. 80
1, 005, 567	4, 259, 642	16, 682, 769	5, 270	22, 345, 944	16, 677, 499	39, 023, 443	20, 225, 760	
872, 494	3, 612, 886	12, 556, 923	89, 863	29, 210, 212	12, 467, 060	41, 677, 272	20, 869, 760	
1, 001, 360	4, 339, 225	21, 526, 153	18, 543	33, 080, 552	21, 507, 610	54, 588, 162	21, 609, 554	
791, 076	3, 427, 996	19, 938, 461	24, 807	23, 003, 271	19, 913, 654	42, 916, 925	22, 358, 293	
835, 535	3, 620, 652	21, 038, 037	47, 123	24, 463, 015	20, 990, 914	45, 453, 929	23, 191, 876	
1, 098, 997	4, 762, 320	17, 921, 913	56, 100	36, 150, 180	17, 865, 813	54, 015, 993	23, 974, 993	
1, 060, 283	4, 594, 560	20, 072, 702	43, 877	32, 469, 652	20, 028, 825	52, 498, 477	24, 843, 547	
1, 076, 102	4, 663, 110	27, 318, 399	58, 607	31, 397, 434	27, 259, 792	58, 657, 226	25, 721, 956	
883, 969	3, 830, 531	37, 422, 270	436, 413	26, 870, 168	36, 985, 857	63, 856, 025	26, 615, 328	
957, 212	4, 147, 918	28, 869, 743	790, 956	24, 868, 119	28, 078, 787	52, 946, 906	27, 586, 113	1. 89
1, 208, 546	5, 237, 034	19, 274, 563	454, 315	22, 356, 534	18, 820, 248	41, 176, 782	28, 349, 746	
2, 324, 688	10, 073, 649	6, 243, 248	207, 931	31, 264, 184	6, 035, 317	37, 299, 501	29, 124, 515	
717, 918	3, 709, 244	23, 824, 189	290, 046	20, 658, 282	23, 534, 143	44, 192, 425	29, 966, 042	
1, 090, 323	5, 633, 335	30, 568, 725	181, 341	30, 704, 477	30, 387, 384	61, 091, 861	30, 685, 586	
1, 183, 893	6, 116, 779	18, 717, 750	79, 439	29, 700, 515	18, 638, 311	48, 338, 826	31, 443, 321	
709, 862	4, 218, 192	19, 301, 032	91, 593	26, 872, 411	19, 209, 439	46, 081, 850	32, 238, 403	
1, 193, 036	4, 407, 019	39, 417, 378	45, 009	23, 860, 716	39, 372, 369	63, 233, 085	32, 987, 985	
1, 781, 848	6, 221, 445	17, 160, 000	39, 290	29, 697, 465	17, 120, 710	46, 818, 175	33, 211, 430	
2, 609, 421	9, 615, 024	6, 275, 738	47, 455	32, 617, 758	6, 228, 283	38, 846, 041	33, 345, 224	1. 45
2, 865, 468	9, 830, 896	848, 766	30, 875	35, 818, 353	817, 891	36, 636, 244	33, 394, 882	
3, 541, 235	11, 037, 099	1, 476, 577	55, 653	44, 265, 439	1, 420, 924	45, 686, 363	34, 324, 665	
[8]4, 009, 321	12, 925, 632	3, 350, 285	59, 544	[7]50, 116, 517	3, 290, 741	53, 407, 258	35, 342, 849	
4, 402, 624	16, 287, 326	3, 076, 297	42, 543	55, 006, 060	3, 033, 754	58, 039, 814	36, 361, 669	
4, 168, 900	16, 016, 727	7, 128, 841	268, 995	52, 111, 252	6, 859, 846	58, 971, 098	37, 400, 130	
3, 821, 461	15, 167, 092	6, 961, 706	299, 672	47, 768, 267	6, 662, 034	54, 430, 301	38, 558, 371	
3, 826, 462	13, 779, 491	11, 821, 501	2, 946, 113	47, 260, 021	8, 875, 398	56, 135, 419	39, 723, 755	
2, 102, 896	12, 211, 785	10, 283, 428	2, 726, 858	42, 057, 924	7, 556, 570	49, 614, 494	40, 967, 095	
2, 205, 621	12, 630, 273	8, 774, 254	3, 055, 836	44, 112, 413	5, 718, 418	49, 830, 831	42, 265, 762	
2, 360, 282	13, 482, 456	7, 226, 878	2, 447, 905	47, 205, 641	4, 778, 973	51, 984, 614	43, 456, 931	1. 15
2, 495, 189	12, 904, 444	9, 415, 328	4, 769, 292	43, 220, 697	4, 646, 036	47, 866, 733	44, 588, 083	
2, 447, 658	11, 159, 774	11, 439, 264	4, 408, 412	39, 213, 805	7, 030, 852	46, 244, 657	45, 687, 668	
1, 812, 525	9, 147, 719	13, 347, 079	3, 470, 827	29, 000, 397	9, 876, 252	38, 876, 649	46, 761, 551	
....	....	....	....	....	....	....	47, 874, 485	

[6] These statistics are from October 1, 1842, to June 30, 1843; nine months.

[7] After 1867, inclusive, the amounts of foreign molasses consumed were obtained from the Annual Reports on "Commerce and Navigation," and not by subtracting the exports from the imports, as was done previous to that date.

[8] The *values* and *amounts* paid for customs after 1866 were calculated on the amount entered for consumption.

TABLE X.—*Production, exports, and consumption of molasses in the United States, for each fiscal year, from 1790 to 1878.*

Years.	Domestic molasses.					Aggregate of all kinds of molasses.				Average consumption per capita.
	Sorghum.	Maple.	Cane.			Consumption.				
	Produce.	Produce.	Produce.	Exports.	Consumed.	Foreign.	Domestic.	Total.	Population.	
FIRST DECENNIUM.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Number.*	*Galls.*
1790	....	[2]200, 000	....	....	....	5, 977, 109	200, 000	6, 177, 109	3, 929, 214	
1791	....	216, 000	....	....	....	7, 181, 885	216, 000	7, 397, 885	4, 049, 247	
1792	....	183, 300	[3]18, 181	....	18, 181	5, 218, 577	201, 481	5, 420, 058	4, 172, 945	
1793	....	233, 300	19, 545	....	19, 545	4, 901, 408	252, 845	5, 154, 253	4, 300, 425	
1794	....	266, 600	21, 818	....	21, 818	3, 469, 690	288, 418	3, 758, 108	4, 431, 802	1. 12
1795	....	216, 600	26, 363	....	26, 363	4, 405, 497	242, 963	4, 648, 460	4, 567, 292	
1796	....	250, 000	30, 909	....	30, 909	4, 852, 934	280, 909	5, 133, 843	4, 706, 926	
1797	....	200, 000	36, 363	....	36, 363	3, 827, 861	236, 363	4, 064, 224	4, 850, 718	
1798	....	233, 300	45, 409	....	45, 409	4, 597, 020	278, 709	4, 875, 729	4, 998, 706	
1799	....	251, 600	54, 545	....	54, 545	4, 038, 331	306, 145	4, 344, 476	5, 151, 117	
SECOND DECENNIUM.										
1800	....	250, 000	90, 909	....	90, 909	4, 053, 555	340, 909	4, 394, 464	5, 308, 483	
1801	....	283, 300	272, 727	....	272, 727	3, 295, 662	556, 027	3, 851, 689	5, 475, 385	
1802	....	266, 600	454, 545	....	454, 545	6, 776, 302	721, 145	7, 497, 447	5, 647, 854	
1803	....	233, 300	363, 636	....	363, 636	6, 686, 848	596, 936	7, 283, 784	5, 825, 758	
1804	....	250, 000	681, 772	....	681, 772	5, 691, 997	931, 772	6, 623, 769	6, 009, 469	1. 20
1805	....	283, 300	754, 500	....	754, 500	8, 973, 226	1, 037, 800	10, 011, 026	6, 198, 858	
1806	....	316, 660	818, 181	....	818, 181	8, 543, 658	1, 134, 781	9, 678, 439	6, 394, 211	
1807	....	300, 000	909, 090	....	909, 090	8, 470, 277	1, 209, 090	9, 679, 367	6, 595, 718	
1808	....	283, 300	1, 272, 727	....	1, 272, 727	6, 481, 671	1, 556, 027	8, 037, 698	6, 803, 567	
1809	....	316, 600	1, 363, 636	....	1, 363, 636	5, 185, 472	1, 680, 236	6, 865, 708	7, 018, 007	
THIRD DECENNIUM.										
1810	....	383, 300	1, 333, 333	....	1, 333, 333	8, 015, 384	1, 716, 633	9, 731, 017	7, 239, 881	
1811	....	343, 384	1, 500, 000	....	1, 500, 000	8, 615, 581	1, 843, 384	10, 458, 965	7, 449, 832	
1812	....	366, 600	1, 583, 333	....	1, 583, 333	8, 133, 263	1, 949, 933	10, 083, 196	7, 665, 973	
1813	....	375, 500	1, 666, 666	....	1, 666, 666	3, 198, 052	2, 042, 166	5, 240, 218	7, 888, 280	
1814	....	400, 000	1, 750, 000	....	1, 750, 000	3, 376, 367	2, 150, 000	5, 526, 367	8, 117, 036	1. 21
1815	....	350, 000	1, 833, 333	....	1, 833, 333	4, 741, 414	2, 183, 333	6, 924, 747	8, 352, 429	
1816	....	383, 800	1, 916, 666	....	1, 916, 666	8, 465, 240	2, 300, 466	10, 765, 706	8, 595, 645	
1817	....	350, 000	2, 000, 000	....	2, 000, 000	11, 466, 491	2, 350, 000	13, 816, 491	8, 845, 887	
1818	....	383, 300	2, 041, 666	....	2, 041, 666	12, 342, 507	2, 424, 966	14, 767, 473	9, 103, 354	
1819	....	416, 600	2, 093, 333	....	2, 099, 333	10, 562, 812	2, 509, 933	13, 072, 745	9, 365, 460	
FOURTH DECENNIUM.										
1820	....	400, 000	2, 250, 000	....	2, 250, 000	9, 752, 569	2, 650, 000	12, 402, 569	9, 638, 453	
1821	....	433, 000	2, 416, 666	....	2, 416, 666	9, 047, 561	2, 849, 666	11, 897, 227	9, 917, 091	

1822	....	466,600	2,500,000	....	2,500,000	11,977,277	2,966,600	14,943,877	10,205,555	
1823	....	383,300	2,887,500	....	2,887,500	13,015,919	3,270,800	16,286,719	10,504,195	
1824	....	450,000	3,080,000	....	3,080,000	13,098,987	3,530,000	16,628,987	10,813,777	
1825	....	483,300	2,887,500	....	2,887,500	12,519,256	3,370,800	15,890,056	11,132,991	1.49
1826	....	550,000	4,331,250	2,070	4,329,180	13,792,443	4,879,180	18,671,623	11,459,903	
1827	....	581,300	6,833,750	5,037	6,828,713	13,356,395	7,410,013	20,766,408	11,803,775	
1828	....	516,600	8,466,631	2,003	8,464,628	13,363,483	8,981,228	22,344,711	12,157,956	
1829	....	571,600	4,642,907	6,640	4,636,267	10,113,304	5,207,867	15,321,171	12,508,898	
FIFTH DECENNIUM.										
1830	....	583,000	6,485,769	13,227	6,472,542	8,347,018	7,055,542	15,402,560	12,866,020	
1831	....	616,000	6,663,461	3,160	6,660,301	17,068,183	7,276,301	24,344,484	13,205,429	
1832	....	575,000	6,663,461	8,310	6,655,151	15,830,897	7,230,151	23,061,048	13,615,826	
1833	....	600,000	6,219,230	7,597	6,211,633	15,674,320	6,811,633	22,485,953	14,019,343	
1834	....	583,000	6,663,461	19,780	6,643,681	17,027,736	7,226,681	24,254,417	14,420,731	
1835	....	616,000	8,884,615	6,543	8,878,072	18,920,827	9,494,072	28,414,899	14,814,243	1.63
1836	....	625,000	2,665,384	2,837	2,662,547	18,008,833	3,287,547	21,296,380	15,270,483	
1837	....	666,000	6,219,230	23,903	6,195,327	16,360,585	6,861,327	23,221,912	15,711,264	
1838	....	633,000	5,775,000	22,067	5,752,933	21,134,313	6,385,933	27,520,246	16,120,891	
1839	....	616,000	6,219,230	11,460	6,207,770	22,973,506	6,823,770	29,797,276	16,509,492	
SIXTH DECENNIUM.										
1840	....	671,920	10,217,307	32,583	10,184,724	19,515,542	10,856,644	30,372,186	17,070,240	
1841	....	625,000	7,803,230	26,663	7,776,567	19,026,242	8,401,567	27,427,809	17,563,990	
1842	....	650,000	8,072,317	63,467	8,008,850	17,631,455	8,658,850	26,290,305	18,065,813	
1843	....	690,000	12,556,923	4,390	12,552,533	11,675,284	13,242,533	24,917,817	18,603,956	
1844	....	325,000	9,000,264	13,073	8,987,191	22,450,684	9,312,191	31,762,875	19,102,946	
1845	....	738,000	17,923,076	69,237	17,853,839	18,003,084	18,591,839	36,594,923	19,640,029	1.83
1846	....	420,000	16,682,769	5,270	16,677,499	22,345,944	17,097,499	39,443,443	20,225,760	
1847	....	470,000	12,556,923	89,863	12,467,060	29,210,212	12,937,060	42,147,272	20,869,760	
1848	....	580,000	21,526,153	18,543	21,507,610	33,080,552	22,087,610	55,168,162	21,609,554	
1849	....	598,000	19,938,461	24,807	19,913,654	23,003,271	20,511,654	43,514,925	22,358,293	
SEVENTH DECENNIUM.										
1850	....	632,965	21,038,037	47,123	20,990,914	24,463,015	21,623,879	46,086,894	23,191,876	
1851	....	641,000	17,921,913	56,100	17,865,813	36,150,180	18,506,813	54,656,993	23,974,993	
1852	....	670,000	20,072,702	43,877	20,028,825	32,469,652	20,698,825	53,168,477	24,843,547	
1853	....	650,000	27,318,399	58,607	27,259,792	31,397,434	27,909,792	59,307,226	25,721,956	
1854	....	1,107,000	37,422,270	436,413	36,985,857	26,870,168	38,092,857	64,963,025	26,615,328	
1855	....	936,012	28,869,743	790,956	28,078,787	24,868,119	29,014,799	53,882,918	27,586,113	1.95
1856	....	897,000	19,274,563	454,315	18,820,248	22,356,534	19,717,248	42,073,782	28,349,746	
1857	[1]1,645	900,000	6,243,248	207,931	6,035,317	31,264,184	6,936,962	38,201,146	29,124,515	
1858	542,000	1,100,000	23,824,189	290,046	23,534,143	20,658,282	25,176,143	45,834,425	29,966,042	
1859	6,747,123	1,275,000	30,568,725	181,341	30,387,384	30,704,477	38,409,507	69,113,984	30,685,586	

[1] The product of sorghum molasses has been determined by the returns of the census of the United States and those of the several States for certain years. The intervening years have been estimated.

[2] The product of maple molasses has been determined from the maple-sugar product. See table for maple sugar.

[3] The product of cane molasses has been determined from the sugar crop of Louisiana from 1823, and by making suitable additions for the crop outside of that State. Previous to that date it has been obtained from the estimated sugar crop. See cane-sugar table.

TABLE X.—*Production, exports, and consumption of molasses, &c.*—Continued.

Years.	Domestic molasses.					Aggregate of all kinds of molasses.				Average consumption per capita.
	Sorghum.	Maple.	Cane.			Consumption.				
	Produce.	Produce.	Produce.	Exports.	Consumed.	Foreign.	Domestic.	Total.	Population.	
EIGHTH DECENNIUM.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Number.*	*Galls.*
1860	7, 176, 042	1, 597, 589	18, 717, 750	79, 439	18, 638, 311	29, 700, 515	27, 411, 942	57, 112, 457	31, 443, 321	
1861	10, 476, 000	1, 600, 000	19, 301, 032	91, 593	19, 209, 439	26, 872, 411	31, 285, 439	58, 157, 850	32, 238, 403	
1862	14, 352, 084	1, 750, 000	34, 417, 738	45, 009	39, 372, 369	23, 860, 716	55, 474, 453	79, 335, 169	32, 987, 985	
1863	17, 940, 105	1, 550, 000	17, 160, 000	39, 290	17, 120, 710	29, 697, 465	36, 610, 815	66, 308, 280	33, 211, 430	
1864	16, 500, 000	1, 500, 000	6, 275, 738	47, 455	6, 228, 283	32, 617, 758	24, 228, 283	56, 846, 041	33, 345, 224	
1865	19, 000, 000	1, 534, 467	848, 766	30, 875	817, 891	35, 818, 353	21, 352, 358	57, 170, 711	33, 394, 882	1. 98
1866	21, 500, 000	1, 341, 000	1, 476, 577	55, 653	1, 420, 924	44, 265, 439	24, 261, 924	68, 527, 363	34, 324, 665	
1867	20, 000, 000	1, 266, 000	3, 350, 285	59, 544	3, 290, 741	50, 116, 517	24, 556, 741	74, 673, 258	35, 342, 849	
1868	18, 500, 000	1, 153, 000	3, 076, 297	42, 543	3, 033, 754	55, 006, 060	22, 686, 754	77, 692, 814	36, 361, 669	
1869	16, 050, 089	934, 000	7, 128, 841	268, 995	6, 859, 846	52, 111, 252	23, 843, 935	75, 955, 187	37, 400, 130	
NINTH DECENNIUM.										
1870	18, 750, 000	921, 057	6, 961, 706	299, 672	6, 662, 034	47, 768, 267	26, 333, 091	74, 101, 358	38, 558, 371	
1871	17, 000, 000	1, 421, 000	11, 821, 501	2, 946, 113	8, 875, 398	47, 260, 021	27, 296, 398	74, 556, 419	39, 723, 755	
1872	16, 000, 000	1, 547, 000	10, 283, 428	2, 726, 858	7, 556, 570	42, 057, 924	25, 103, 570	67, 161, 494	40, 967, 095	
1873	15, 000, 000	1, 632, 000	8, 774, 254	3, 055, 836	5, 718, 418	44, 112, 413	22, 350, 418	66, 462, 831	42, 265, 762	
1874	16, 000, 000	1, 678, 920	7, 226, 876	2, 447, 905	4, 778, 973	47, 205, 641	22, 457, 893	69, 663, 534	43, 456, 931	1. 55
1875	15, 000, 000	2, 022, 756	9, 415, 328	4, 769, 292	4, 646, 036	43, 220, 697	21, 668, 792	64, 889, 489	44, 588, 083	
1876	14, 000, 000	2, 146, 281	11, 439, 264	4, 408, 412	7, 030, 852	39, 213, 805	23, 177, 133	62, 390, 938	45, 687, 668	
1877	13, 000, 000	2, 000, 000	13, 347, 079	3, 470, 827	9, 876, 252	29, 000, 397	24, 876, 252	53, 876, 649	46, 761, 551	
1878	....	....	....	....	....	....	....	....	47, 874, 485	

APPENDIX.

WHEAT EXPERIMENTS.

The Department of Agriculture has distributed to the States two varieties of wheat, namely, *Triticum Hibernum*, commonly called winter or fall wheat, and *Triticum Æstivum*, spring or summer wheat.

ALABAMA.—From this State successes are reported from different portions, with Golden Straw, Sandford, and Gold Medal (winter wheats), sent out by the department, giving yields ranging from 6 to 20 bushels per acre; rust has been severe in some localities.

ARKANSAS.—Meager returns only are received from this State. Two reports show that the Silver Chaff and Golden Straw (winter) have given 8 to 20 bushels per acre. Two varieties of spring wheat (Sherman and Golden Globe) have done moderately well in a few cases; one report states a yield of 50 bushels per acre from the Sherman.

FLORIDA.—Only one success is reported, that with the Sandford, 18 bushels per acre, good quality; rust has prevailed in most parts of this State.

CONNECTICUT.—Reports have been received from correspondents in this State on one variety of spring wheat, the Sherman; and one variety of winter wheat, the Arnold's Gold Medal. Yield of the latter is reported as ranging from 16 to 35 bushels per acre, or superior grain; one report shows 5 bushels from one peck of seed. Yields of 15 to 20 bushels per acre have been obtained with the Sherman, of good grain; both are reported as well adapted to different portions of the State. Soaking seed wheat in a brine of blue-stone, or of salt, 10 to 15 hours and rolling in lime or plaster, is reported to be very generally a security or preventive to smut in the crop, and frequently as a preventive against rust, while it often also prevents ravages by fly and other insects.

MAINE.—From this State reports have been received of results of experiments with four varieties of wheat, Gold Medal and Silver Chaff, winter, and two of spring, the Golden Globe and Sherman. Of the two latter, the Golden Globe gave best results, yielding variously from 15 to 30 bushels per acre; the Sherman yielding 10 to 22 bushels per acre. Of the two winter wheats, the rate of yield is not given, but the reports say they "give good yield, fair grain, and prove satisfactory."

VERMONT.—Reports in regard to two varieties are received from this State, the Clawson, winter wheat, and the Sherman, a spring wheat. The yield of the former is not reported, but it is said to "do well, and is satisfactory." The latter is reported to yield 24 bushels per acre.

RHODE ISLAND.—From this State reports in regard to two varieties have been received, Gold Medal (winter) and Sherman (spring). Reported yield of the former, 23 bushels per acre, of fine quality; the latter is reported as a total failure from rust.

NEW HAMPSHIRE.—To this State two varieties of spring wheat and one of winter wheat were distributed. The Silver Chaff gave four bushels for four quarts of seed sown, of superior quality. The Sherman gave 15 to 33 bushels per acre; and the Golden Globe (spring) 18 bushels per acre. Salt, lime, ashes, and plaster are used on wheat-land with excellent effect in this State.

MASSACHUSETTS.—To this State the department has distributed two kinds of spring wheat, Golden Globe, and Sherman; and one of winter wheat, Arnold's Gold Medal. Reports show the yield of Gold Medal as 16 bushels per acre, good quality; Sherman, 20 to 25 bushels per acre, and Golden Globe much less.

PENNSYLVANIA.—Correspondents report in regard to 5 varieties of winter wheat, the Gold Medal, Gold Dust, Sandford, Sandomirka, and Silver Chaff; and 2 of spring wheat, the Golden Globe and Sherman. Gold Medal yields from 15 to 40 bushels per acre. Gold Dust, but lightly. Sandford, 25 bushels; a beautiful grain. Silver Chaff, 10 to 25 bushels. Sandomirka (Poland), 20 bushels, very good. Golden Globe, 10 to 20 bushels per acre. Sherman, 10 bushels.

NEW YORK.—Reports have been received from this State in regard to experiments with 6 varieties of wheat, namely, Gold Dust, Gold Medal, Silver Chaff, and Sandomirka (Poland), *winter* wheats; and Golden Globe and Sherman, *spring* wheats. Yield reported from Gold Medal varying from 12 to 40 bushels per acre; from Gold Dust, very little—failed from rust; from Silver Chaff, 25 bushels per acre; from Sandomirka no yield reported; from Golden Globe, 8 to 16, very poor; from Sherman, small yield, nearly a failure.

NEW JERSEY.—To this State have been distributed, from which returns have been received, four varieties of wheat, Gold Medal, Gold Dust, Sherman, and Golden Globe, the latter two spring wheats; best results are reported from the Gold Medal.

CORN.

ALABAMA.—The several varieties of field corn received in this State from the department are uniformly reported as being superior and more advantageous than the common kinds grown there. One report says Cooley's early white is a great success, and more valuable than other sorts, being a month earlier. Another, the Maryland yellow is early, a good, rapid grower; better for both grain and fodder than other kinds.

MAINE.—Reports show that the Compton corn, distributed by the department, succeeds well in this northern climate. One report, planted May 15, gathered September 27, yield 80 bushels of ears, heavy grain. Another, planted May 22, gathered October 4, yield 128 pints for one planted; good growth of fodder.

NEW HAMPSHIRE.—One report, Pennsylvania Early, planted May 20, gathered September 27; yield, 50 bushels per acre, partly destroyed by frost. Another, planted June 1, cut September 23; yield, 816 quarts from 6 quarts planted, being 136 fold. Another, Compton, planted May 25, gathered October 1, grew large and rank, but season too short to ripen much of it.

VERMONT.—One report, Compton, planted May 16, gathered September 27, stalks grew 9 feet high, ears 13 inches long; yield large; later than our common 8-rowed variety. Another, planted in May, cut October 8; yield, 7 bushels from 1 quart of seed, being 224 fold; another, some ears weighed one pound each. No other variety reported, except sugar-corn, which does well.

NEW YORK.—One report, Compton, planted May 8, gathered September 15; yield, about 80 bushels to the acre, 125 fold. Another, White Dent, planted May 30; largest growth ever before seen here—but rather late; if planted earlier will do better; another, the finest corn ever here. One report on Compton, planted May 15, gathered September 15, yield about 50 bushels per acre, good weight.

PENNSYLVANIA.—Compton, planted June 4, gathered October 10; yield, 328 quarts from one quart planted. Another, Hominy corn, planted May 10; "the best corn I grow." One report, the Small Flint does well in our short seasons.

NEW JERSEY.—No encouraging success reported from this State, except with sugar-corn. Compton and White Prolific generally failures from various causes, worms, squirrels, and drought. One report says Compton is superior to others.

MARYLAND.—Meager reports from here, and only partial success reported.

VIRGINIA.—Prolific, reported on favorably, giving 3 to 4 ears to the stalk, matured well. Another, good, early, 6 ears on some stalks; corn from department yields considerably more than common varieties.

WEST VIRGINIA.—Reports but few and little success from this State.

NORTH CAROLINA.—Maryland and Pennsylvania yellow, and Runner's white, from department, are productive, desirable, and nice for bread, particularly the latter. Another, White Prolific yields well, 2 to 3 ears on a stalk; many prefer the white corn.

SOUTH CAROLINA.—One report, the corn from the department is a great acquisition here. Another, yields largely, 3 to 5 ears on a stalk; the corn did very well considering severity of the drought.

GEORGIA.—Reports from this State show valuable results from the corn distributed by the department; both yellow and white varieties have done well and surpassed, in earliness and yield, all the common sorts. One report, Shipley's Early, valuable, prolific; ears large, cobs small, kernels long. Another report makes "two crops a year with the yellow Dent;" another, White Prolific, month earlier, and 5 large ears on a single stalk.

FLORIDA.—Runner's white, Maryland yellow, Westchester and Prolific white, all reported favorably upon; but "Compton is a great acquisition," being earlier and yielding more than any other, and "giving two crops a year," and yields 90 fold; some stalks giving 5 to 8 ears each, large, long, and plump.

MISSISSIPPI.—Prolific white corn, from the department, planted March 10; glazed July 1; too hard for table use; very prolific on rich land, 3 to 5 ears on a stalk. Another report, 10 feet high, 2 to 4 long ears on a stalk; Compton corn from the department, very early, 3 or 4 ears on each stalk. Another, planted in March, matured in August; best early variety ever seen here. Another, yield 100 fold and valuable.

LOUISIANA.—The Cooley, Pennsylvania yellow, and White Prolific, have all given good results, the latter making 7 and 8 good ears to a single stalk, long and well filled; is an acquisition.

TEXAS.—White Prolific, yellow, and other varieties, from the department, have proved valuable. Reports: early, large yield, 3 to 5 ears on a stalk, at least one hundred fold. Another, the corn from department is a great acquisition to this section of country.

TENNESSEE.—Reports but meager from this State; no valuable results except with sugar-corn, the Mammoth and Stowell's Evergreen, which have given great satisfaction.

KENTUCKY.—The few reports received from this State show the Cooley and White Prolific to be valuable.

OHIO.—Corn from the department has proved desirable and prolific. One report, earlier than common corn, yielding 100 fold; another, very luxuriant growth, and many ears to the stalk. One report, 60 to 75 bushels per acre, good corn; another, grows well and yields very satisfactory.

MISSOURI.—One report, Kendrick's white corn, the best here. Both yellow and white corns are valuable and have done well; another, Pennsylvania yellow very highly prized. Baden and "Long John" are best in Boone County.

ARKANSAS.—Reports say, the Maryland yellow and Chester yellow have done well; another, the Pennsylvania yellow, from the department, has proved to be the most profitable; another, these early, heavy, yellow corns would be liked better if white. One report says, "the Prolific White is very prolific indeed, averaging 3 ears to the stalk; shall plant it next season."

KANSAS.—Compton grew well, yield large; White Prolific grew finely, giving average of 3 ears to the stalk, and 90 bushels the acre. Good grain. Another, Compton, yields 320 fold. Hominy corn, planted April 18, yields 45 bushels per acre, and superior to any other white corn grown here.

NEBRASKA.—One report, Brown corn is the best grown here; another, the Pennsylvania yellow a failure; the Compton, planted April 18, gathered September 10, yield 25 bushels per acre. Grain rather poor and small.

ILLINOIS.—One report says, the Compton corn yields with good treatment on rich soil 1,000 fold for the seed planted, and 100 bushels the acre in some instances; another, the Pennsylvania yellow, yields 800 fold.

INDIANA.—Reports prove that department corn has succeeded admirably in this State. One report, earlier than our standard varieties, and yields well of good grain. Another, planted 29th May 8 pints, gathered September 30, 4,160 pints (65 bushels), being 520 fold for one planted—extraordinary yield.

MICHIGAN.—One report, Compton corn, from the department, planted May 25, gathered August 25, early; yield 80 bushels per acre, good ears, am delighted with it, and can recommend for general cultivation; another, 60 bushels per acre, shelled; one report says only 30 bushels of ears per acre, and liable to smut, not desirable here. Another says, Cooley yields 68 bushels, per acre; another, the Pennsylvania yellow gave 100 bushels per acre, but requires a longer season than generally occurs here.

WISCONSIN.—Failures generally reported. The Prolific White and the Compton grew well, the latter 14 feet high, but both sorts too late; fail to mature before frost.

MINNESOTA.—Compton and Early White only reported on; both failures with one exception, from requiring too long seasons; one report from Todd County, Compton grew 14 feet high, 3 ears to a stalk, but frost prevented its ripening, but in Dakota County Compton grew 14 feet high with 3 to 6 ears—planted May 10, gathered October 15; thus it succeeded in this part of the State.

IOWA.—Early yellow reported no earlier or better than Cherokee. Compton, early, large ears and long, grain perfect; another, planted May 10, gathered November 10, yield large and grain good—100 fold for seed planted; should have been planted somewhat earlier for this climate to secure even better results.

INDIAN TERRITORY.—Report from Chickasaw Nation says, White Prolific, planted too late, 1,550 pounds from 8 pounds planted, 4 to 6 ears on a stalk; this is about 180 fold for one planting.

UTAH.—One report, yield about 20 to 25 bushels per acre, one says, planted May 3, frost killed it September 10; another, eaten by grasshoppers.

NEVADA.—One report, the Hominy corn, from the department, planted July 12, gathered October 16, yield 55 fold for one planted.

CALIFORNIA.—One report, Pennsylvania yellow, planted April 25, 5½ pounds seed per acre—harvested September 1, early, yield 59 bushels per acre. Another, Egyptian corn, grows well, yields 100 bushels per acre—good grain. One says, Compton entirely destroyed by a worm, that destroys all but the "White Spanish" corn.

OREGON.—Only one report received—that on Pennsylvania yellow, killed by frost.

GARDEN AND FLOWER SEEDS.

Reports received of experiments with garden and flower seeds distributed by the department show that large benefits have very generally been realized from the former, and particularly so in the extreme Southern States, where the cultivation of vegetables has become more general than was formerly the case, especially for home use.

ALABAMA.—The reports very generally state that successes have resulted with nearly or quite all of the many varieties of seeds received from the department—asparagus, beets, beans, cabbage, corn, melons, onions, peppers, pease, parsnips, potatoes, ruta-bagas, turnips, &c. Particularly noticeable is the increasing attention given to the growth of beets, sugar-corn, and turnips, confessedly with profitable results, everywhere responded to with thanks from the recipients of the seed. One report says the new varieties of potatoes are of great advantage. Another, that the sugar-corn is a

great acquisition. Others, that the tomatoes are fine, some weighing 1½ pounds. One that the potatoes yield largely, some 12 good tubers to a single vine.

MARYLAND.—Beans, beets, cabbage, celery, lettuce, melons, onions, pease, squashes, tomatoes, and some other seeds, distributed by the department, are reported as having proved successful and valuable in all parts of the State; particularly the black wax beans, the celery and lettuce, have proved superior, and are highly valued.

VIRGINIA.—Growing garden vegetables is on the increase in this State; and seed distributed from the department is reported uniformly to be satisfactory. Nearly all of the most important varieties of vegetable and flower seeds cultivated in our country have been sent out by the department. One report says the beans, beets, carrots, cabbage, celery, corn, egg-plant, lettuce, melons, onions, okra, pease, parsnip, radish, tomatoes, turnip, and others distributed have been successfully grown, and many of them are pronounced the best ever seen in the State.

WEST VIRGINIA.—In this State, as in Virginia, the various garden and flower seeds received from the department have done well and given good satisfaction. One report says the sweet beet is one of the most productive crops we can raise. Another, the Little Gem pea very prolific, and when planted early gives two crops in a season. Another, all the seeds sent last spring are suitable, grew well, and give good satisfaction.

NORTH CAROLINA.—Beans, beets, cucumbers, egg-plant, pease, tomatoes, turnips, and other garden seeds, as well as the various flower seeds, distributed by the department, are reported from all parts of the State as satisfactory and valuable.

SOUTH CAROLINA.—Beans, celery, corn, cabbage, flowers, lettuce, onions, pease, turnips, and other sorts, are reported as successful and satisfactory, from seeds sent there by the department. Cucumbers and melons are reported superior in quality and yield. Noticeably the "Blue Peter" pea, from a small bed, gave a peck a day for full two weeks. One report says the radishes, 10 inches long, were tender and superior. Cucumbers reported a dozen in a bunch, each 5 to 6 inches long. Sugar-corn averaged 3 to 4 good ears on a stalk.

GEORGIA.—One report says the full assortment of seeds, including asparagus, beans, beets, cabbage, carrots, corn, melons, onions, pease, turnips, tomatoes, and many others, sent from the department, are reported as successful and valuable in most parts of the State. Particularly cabbage and melons give large yield.

FLORIDA.—In this State trials with seeds from the department have been for the most part reported successful; asparagus, beans, celery, corn, flowers, lettuce, melons, okra, onions, parsnips, ruta-bagas, squashes, turnips, and most root crops have been received there and reported upon as giving great profit and satisfaction. One report says, the beans, garden corn, and melons are the finest ever raised in that section.

LOUISIANA.—Beans, cabbage, sweet corn, potatoes, tomatoes, and other garden seeds, received from the department, are reported as having given profitable results and excellent satisfaction. Melons, potatoes, and tomatoes are reported as exceptionably fine.

MISSISSIPPI.—The garden or sugar corns received from the department are reported as superior both in yield and richness to all others, and also earlier. Similar reports are made in regard to beans, cabbage, tomatoes, and all other vegetables; all seeds reported valuable and highly satisfactory.

TEXAS.—One report, vegetables from seed distributed by the department thrive and give great satisfaction in most parts of this State. Beans, beets, cabbage, corn, flowers, lettuce, melons, onions, radishes, pease, tomatoes, all do well. Onions, sugar-corn, melons, and tomatoes are noticeably fine and valuable; corn early, short stalks, and long ears; cucumbers in 8 weeks and superior.

TENNESSEE.—All vegetable seeds from the department reported as being very successful, in quality, earliness, and yield. Mexican (white) onions reported 5 to 6 inches in diameter. Wax-beans were planted March 30 and matured for the table May 20; lettuce, fine large crisp heads; cabbage, superior; egg-plant, tomatoes, all excellent, productive, and valuable to the country. Sugar-corn is reported as very early and delicious. Lettuce reported without an equal. Pease superior, every way.

KENTUCKY.—Few reports from this State, but they show useful results from such trials as were made, with most of the varieties sent out, such as beets, cabbage, sugar-corn, sorghum, turnips, and tomatoes, with some others; one report, beets, 5 inches diameter, and cucumbers 12 inches long; both yield better than any others before grown here.

OHIO.—All varieties of seeds distributed to this State from the department are reported as succeeding well, generally better than those previously grown. Beans, beets, and carrots are reported as splendid; root-crops as very valuable; "parsley a perfect beauty"; cabbage and cucumbers extra fine and prolific. One report, the onions and sugar-corn, superior, delicious. Tomatoes, superior in yield and quality.

ILLINOIS.—From this State reports come that the flower and garden seeds from the department have been of much value to producers; all varieties have succeeded well, and proved more prolific than similar sorts commonly grown. Beans, sugar-corn,

cucumbers, onions, and most of the root-crops are reported as particularly productive; cabbage, pease, and tomatoes are reported on favorably. One report states that the sugar-beet grows finely and is good, not only for sugar, but for stock. Another, that the black wax-beans and the Butman squash do well, and are superior to all others known there; so the white Mexican onion, large, tender, and fine for market. One lady reports the vegetables and flowers "are all just splendid."

INDIANA.—Reports are not so numerous and general from this State, but those received make very favorable statements of the experiments with the score or more varieties received there; beans, cabbage, pease, and tomatoes are highly spoken of; Hancock's early pea and paragon tomato very early, prolific, and greatly prized.

MICHIGAN.—From this State reports in regard to the seeds sent to them show valuable results, very uniformly. One report, sugar-corn excellent; early pease, planted April 30, and picked in June; cauliflowers, cabbage, and tomatoes, all give great satisfaction. Flowers succeed very well in most sections. Mammoth sugar-corn, very early, and best ever grown, 80 bushels per acre. Ruta-baga, fine and valuable; lettuce, superior; all roots succeed admirably.

IOWA.—Large proportion of the reports on seeds sent to this State from the department show valuable results, and that they give complete satisfaction. One report, turnips superior; another, pease exceedingly fine; cabbage early, large, and fine; melons superior; lettuce and radishes crisp, early and late; sugar-corn, good, early, prolific; the flower seeds all gave perfect satisfaction, "and are beauties."

WISCONSIN.—Vegetables and flowers, from seeds sent from the department, are reported valuable and a success in most portions of this State. Particularly beans, cabbage, sugar-corn, melons, and root crops have given extra good results; sugar-beets have produced large yield. One report, the Crosby cabbage a valuable acquisition; another, the Weathersfield onion very fine and prolific.

MINNESOTA.—Seeds of vegetables and flowers, sent to this State, are reported as successful and being very valuable. Beans, cabbage, pease, tomatoes, and others reported very early, fine, and prolific; Mexican and Danverse onions reported early and prolific; sugar-corn is reported as being satisfactory, especially "Pratt's early," 3 weeks earlier and preferred to all others. Red peppers are reported 4 inches long and 2 inches in diameter. The Egyptian turnip-beet is reported as very superior.

MISSOURI.—Reports on garden and flower seeds are not numerous from this State, but are favorable and show valuable successes with nearly all sorts, especially with beans, onions, and tomatoes. One report speaks of the wonderful growth and superior quality of Stowell evergreen sweet corn. Very satisfactory results are reported with the flower seeds received from the department.

KANSAS.—Onions, parsley, carrots, beans, pepper, tomatoes, and all others have grown and yielded well, and given complete satisfaction, particularly Danverse onions, black wax-beans, and cabbage; patty-pan squash and sugar-corn best ever had here; the "sugar-beets gave 128,000 pounds good roots to the acre," nearly 6¼ tons, on sandy loam soil. (That would feed as many cattle, and feed them better, than the hay ordinarily obtained from three acres.)

ARKANSAS.—The beans, beets, cabbage, carrots, lettuce, melons, onions, parsnips, potatoes, ruta-bagas, squash, turnips, tomatoes, and others are reported as giving profitable results in various parts of the State. Advantages are acknowledged particularly from the introduction of improved beets, corn, potatoes, and tomatoes, and with most root crops, as larger and more general growth of those useful vegetables has been stimulated by the receipt of better sorts.

NEBRASKA.—Reports of experiments with the seeds received from the department show very general success and value. One report says beets and onions splendid and prolific; another, corn and pease are remarkable, early and good beans; another, cabbage, turnips, and tomatoes give good satisfaction; another, sugar-beets yield enormously. Stowell's evergreen sugar-corn superior to any other grown here.

OATS.

Several improved varieties of oats (*Avena Sativa*) have been distributed by this department—one of winter oats; and a variety of spring oats called the "Board of Trade" oats. Following are reports of results from correspondents in different States of experiments with these grains:

MAINE.—Board of Trade, sowed May 11; yielded bountifully, weighing 47 pounds the measured bushel. Another, large yield per acre, weighed 40 pounds the bushel. No experiment with winter oats is reported from this State.

CONNECTICUT.—Board of Trade, sowed April 17; harvested July 25; yield, 38 bushels per acre of heavy grain. Winter oats not reported.

NEW JERSEY.—The Poland and white Dutch oats are reported as doing well in this State.

NEW YORK.—Winter oats reported a failure here. Board of Trade oats sown May 15; cut August 19; yield 40 bushels per acre, weighing 37 pounds per measured bushel.

Another reports them sound, plump, and two weeks earlier than others; wonderfully well headed, but injured by heavy rain, followed by rust in some cases.

PENNSYLVANIA.—Winter oats drilled in October 3; harvested June 20; splendid growth; one-third better than spring oats; stands the winter well; yields 30 to 42 bushels per acre, weighing 39 pounds per measured bushel. Board of Trade oats sowed April 8; harvested July 20; yielded 20 to 50 bushels per acre, weighing 40 pounds per measured bushel; are two weeks earlier than other spring oats; grain plump and heavy. Another report: Sowed April 18; harvested August 15; heavy yield and heavy grain.

KANSAS.—Winter oats, sowed in September; cut June 13; yield, 58 bushels per acre; weight per measured bushel, 40 pounds. Other reports show the yields to be from 30 to 50 bushels per acre, plump grain. Board of Trade oats sown in April; cut July 20; yield, 75 bushels per acre; good, heavy grain. Other reports place the yield at 35 to 50 bushels per acre, and state that they resist the rust better than other kinds. One report says: "Drilled in March 20; cut July 20; yield, 80 bushels per acre, heavy, plump grain. This was grown on clay loam, plowed deeply."

NEBRASKA.—Winter oats generally winter-killed. One report: Sowed September 20; cut July 30; yield, small; grain, light. Board of Trade oats sown April 29; cut July 19; yield, 63 bushels per acre; heavy grain.

OHIO.—Winter oats, sowed October 1, harvested June 15, yielded 53 bushels per acre, extra quality; another reports failure from winter-killing. Board of Trade, sowed March 10, cut July 15; yield, 40 bushels per acre. Another, sowed in April, cut August 1; yield, 64 bushels per acre; weight, 42 pounds per measured bushel.

MICHIGAN.—Board of Trade oats, sowed April 30, cut August 1; yield, fair, quality good; another, sowed, May 2, cut July 23, yield large—over 32 bushels per acre—weight of grain heavier than other kinds, some stalks 6 feet high. No success with winter oats reported.

WISCONSIN.—Board of Trade oats, sowed May 1, cut August 15; yield, 45 bushels per acre, heavy grain. Another, sowed May 10, cut July 24; yield, 55 bushels per acre, first-class grain. Another and better still were sown April 15, cut last of July; yield, 98 bushels per acre; weight, 54 pounds per measured bushel. Seed soaked 24 hours in salt brine, grown on sand-clay land, deeply plowed. No success with winter oats reported in this State.

ILLINOIS.—Both winter and spring oats are reported quite successful in this State. Board of Trade oats, sowed April 5, harvested July 28; yield, 40 bushels per acre, large, white, heavy, grain. Other reports state the yield ranging from 20 to 60 bushels per acre, and weighing from 34 to 36 pounds per measured bushel. One report says, 40 stalks from a single seed; some stalks 5½ feet high, heads 18 inches long, the finest oats ever seen here. Another, sowed March 25, harvested July 15; yield, 48 bushels per acre, heavy grain. Winter oats, sowed November 1, harvested July 1; yield, 40 bushels per acre, heavy grain. Another, sowed October 5, harvested June 28, very large yield; one stool had 67 stalks, others 20 stalks. One report, sowed October 27, harvested June 25; yield, 60 bushels; weight, 35 pounds per measured bushel.

INDIANA.—Board of Trade oats, sowed March 2, harvested July 13; yield light; quality fair. Another, sowed April 15, cut July 15; yield, 50 bushels per acre, plump, heavy grain. Winter oats sowed in September, cut in July; yield per acre ranging from 30 to 50 bushels per acre, weighing from 34 to 40 pounds per measured bushel, and growing over 5 feet high.

MINNESOTA.—No winter oats reported. Board of Trade oats, sowed April 1, cut July 18; yield, rate of 70 bushels per acre. Another, sowed March 26, cut August 10; yield, 75 bushels per acre; weight, 38 pounds per measured bushel. These are from seed distributed by the department.

IOWA.—All reports of winter oats tell of failures from winter-killing. Board of Trade oats, sown March 9, cut July 17; yield, 56 bushels per acre; weight, 38 pounds per measured bushel. Other reports show yields from 50 to 60 bushels per acre, plump, heavy grain.

IDAHO.—One report says: "Sowed April 6; cut August 31; yield, 71 bushels per acre; weight, 35 pounds per measured bushel. Grown on prairie land."

RYE.

ALABAMA.—The department distributed a white winter rye (*Secale Cereale*) to most parts of the country; but few reports have been received, which generally state that it grows well, makes large yield, and is a valuable acquisition. One report says: "It was sown in December, and grew rank and tall, heavy straw and long heads, but was severely injured by rust in the spring on account of late sowing."

PENNSYLVANIA.—The winter rye sent from the department grew well and stood up much better against the hail-storm than other varieties, yielding large, plump grain, very productive. Another reports: In this State the Silver Hull (buckwheat) is succeeding well, and is very desirable.

VIRGINIA.—From this State, the winter rye sent by the department is reported to yield one-third more than other varieties grown.

NORTH CAROLINA.—White winter rye, from department, sowed in January (altogether too late), a portion of it came up and spread out well, but failed to head good on account of late sowing.

TENNESSEE.—The winter rye sent here grew well and yielded handsomely. This is the only report from this State.

OHIO.—White winter rye is reported a good grain, yielding 35 bushels per acre, but darker in color than the seed received from the department.

ARKANSAS.—Sowed in autumn on clay land, yielded at rate of 27 bushels per acre; best ever seen in the neighborhood. One report, the winter rye from the department is very satisfactory, doubling yield of all others. The spring rye was killed by hot weather.

WISCONSIN.—One report states, the winter rye was sown September 15, cut July 28; yield, rate of 54 bushels per acre—superior grain. Another, 12 bushels for 8 quarts sown—sound, fine grain.

IOWA.—Reports show fair success with winter rye; sowed September 15, cut July 8; yield, rate of 24 bushels per acre, good grain. Another gives large yield, large plump grain.

KANSAS.—Winter rye, sown September 28, cut June 10; yield large and grain good. Another, sowed September 26; yield, 30 bushels per acre, good grain.

NEBRASKA.—Winter rye sent from the department grew finely and yielded 50 bushels per acre, heavy grain.

BARLEY.

MAINE.—The larger portion of the barley from the department to this State was of spring variety, known by the name of Mensury, reports from which very generally show fair results. Time of seeding, May and first week of June; harvesting done latter part of July and August; yield varying from 10 to 30 bushels per acre; one report shows 45 bushels per acre, weight of grain 48 pounds per measured bushel.

VERMONT.—The barley distributed to this State by the department is reported as giving great satisfaction. The Mensury variety, sowed April 26, cut July 29; yield, 33 bushels per acre; weight, 46 pounds per measured bushel; the best barley grown in this section.

NEW YORK.—The reports from this State on Mensury (spring) barley show it to be well adapted to that region. Time of sowing, the first of May; time of harvest, first week in August; yield, one report, rate of 50 bushels per acre, very fine grain; another, 40 bushels, very white and fine. One report on winter barley, sowed rather late, but grew 4 to 5 feet high, an excellent crop. The experimenter says, "the distribution of seeds by the department has been of very great value to this section of country."

ALABAMA.—No reports of spring barley received from this State. The Canada 6-rowed (winter variety) is generally reported to have yielded well, though sometimes the reverse.

FLORIDA.—Only meager reports in regard to barley have been received from this State, barley not being much grown.

MISSISSIPPI.—Only the Canada 6-rowed barley is reported from this State. Sowed from September to October, and harvested in June; yield, rate of 35 bushels per acre, fine grain.

TEXAS.—The Canada 6-rowed barley is the only variety reported from this State; the sowing in November and December, the harvest in May and June; yield, from 15 to 40 bushels per acre, very fine grain.

MARYLAND.—Only meager reports from this State in regard to barley.

VIRGINIA.—The Canada 6-rowed is the only variety of barley in regard to which reports have been received from this State; seeding done in September and October; harvesting mostly in June and first week of July; yield ranging from 7 to 50 bushels per acre, generally plump, heavy grain. In all of the States this variety has been remarkably free from attacks by rust; it has suffered rather more frequently in this State than most others.

WEST VIRGINIA.—Only the Canada 6-rowed barley is reported on from this State; sowing September to November; harvest from June 1 to July 15; yield ranges from 4 to 10 bushels per acre; frequently destroyed or badly injured by winter-killing, and not generally adapted to this State.

NORTH CAROLINA.—The Canada 6-rowed is the principal barley reported on from this State, only one instance of the Mensury (spring) being reported, in which the seeding was done April 17, the harvesting July 30; yield, about 8 bushels per acre, fair grain. Sowing of the Canada 6-rowed was done from middle of September to first part of November, and the harvest from middle of May to July 20; yield ranges from 12 to 60 bushels per acre, good quality of grain.

SOUTH CAROLINA.—The general crop of barley in this State is the Canada 6-rowed, which was sowed from September 1 to November 15, and harvested from April to June yields range from 10 to 37 bushels per acre, grain good.

GEORGIA.—In this State Canada 6-rowed barley is reported as sown mostly in Octo-

ber and November, and harvested in June and July; yield, from 15 to 50 bushels per acre—a great acquisition to the crops of the State—53 pounds per bushel. One report says, Mensury barley (a spring grain) was sown December 13, and cut June 5; yield of 40 bushels per acre, weighing 53 pounds per measured bushel.

TENNESSEE.—Only the Canada 6-rowed barley is reported on from this State; sowed in September and November, harvested in June and July; yield, from 10 to 35 bushels per acre, some weighing 44 pounds per measured bushel.

KENTUCKY.—The Canada 6-rowed reported in this State to be sown from middle of September to middle of October, and harvested from June 18 to July 10; yield, from 13 to 60 bushels per acre, plump, heavy grain. No spring barley reported.

MISSOURI.—Reports from this State show that barley, particularly the Canada 6-rowed, is extensively grown. The season of sowing is from September 1 to middle of October, and time of harvesting from last of May to last of July; yield, from 10 to 45 bushels per acre, good, heavy grain. One report shows that the winter barley received from the department succeeds well; sowed October 11; yield, from 12 quarts sown, 15 bushels good grain. Another, sowed October 15, 4 quarts from the department; yield, 7 bushels, or 56-fold, good grain. One report in regard to the Mensury (spring), sowed April 5, cut in July; yield, 36 bushels per acre, superior grain.

ARKANSAS.—Reports from this State of Canada 6-rowed, give the sowing from September to December, and harvest from May to June; yield, ranging from 35 to 60 bushels per acre, and one instance is reported of 90 bushels per acre, from heavy clay land, plowed deeply, sowed with drill February 1, and harvested June 11, 1878. No spring barley is reported.

INDIANA.—The winter barley distributed by the department to this State is reported as very successful. Time of sowing, September and October; of harvesting, June and July; rate of yield, 13 to 50 bushels per acre, plump, heavy grain. One report says, sowed October 2, cut June 25; yield, 2 per cent. better than any other. Another, drilled-in August 20, cut June 20; yield, rate of 40 bushels per acre; grain, very good.

MICHIGAN.—The Canada 6-rowed winter barley from the department is reported generally as making large yield and profitable product. Time of sowing, very generally, September and October; of harvesting, mostly in July; yield, from 20 to 45 bushels per acre; grain good quality. Two reports on the Mensury (spring) barley, sowed in April and harvested in July and August, gave rate of yield 28 and 32 bushels per acre.

WISCONSIN.—Reports from this State show a larger proportion of spring barley, the Mensury variety, than any other to have been sown. Time of sowing, March and April; harvesting, July and August; rate of yield, 30 bushels per acre; grain good, and adapted to the region. The Canada 6-rowed (winter) is largely raised; time of sowing, September and first half of October; of harvesting, mostly in July; yield, rate of 13 to 88 bushels per acre—the latter case shows weight 58 pounds per measured bushel, grown on clay soil.

MINNESOTA.—From this State reports of successes with both the spring and the winter barley distributed by this department have been received. The Canada 6-rowed winter was generally sown in October and harvested in July, giving a rate of yield from 10 to 27 bushels per acre, heavy grain; many reports state entire winter-killing. The Mensury spring barley generally sown in April, and cut latter part of July; yield ranging from 25 to 40 bushels per acre, extra quality. No cases of rust reported in this State.

IOWA.—Both the Mensury (spring) and Canada 6-rowed (winter) are reported as succeeding in this State with winter-killing in some localities. Canada 6-rowed is generally sown in September and cut in July; yield about 10 to 42 bushels per acre. Mensury is sown in March and April, harvested in July, and yields 20 to 80 bushels per acre, heavy, plump grain. The large yield of 80 bushels was obtained from clay-loam soil, deep-plowed, sown March 20 with drill, cut July 4, grown in Dubuque; reported the best barley ever seen here.

NEBRASKA.—From this State reports are that the Canada 6-rowed barley succeeds well; sown generally in September, and cut early in July; yield ranges from 15 to 32 bushels per acre, plump grain, weighing 54 to 59 pounds per measured bushel. One report with Mensury (spring) barley, sown April 10, cut July 6; yield, 52 bushels per acre; weight, 58 pounds per measured bushel.

COLORADO.—One report shows the Canada 6-rowed (winter) barley, sown in November, cut in August, yield about 35 bushels per acre; grain good. Another report shows the Mensury (spring) barley sown in March, cut August 1; yield, rate of 20 bushels per acre, good grain, but not quite equal to the Canada 6-rowed. Both suited to this Territory.

DAKOTA.—In this Territory reports show that the Mensury (spring) barley is sowed in May, cut in August; yield 30 bushels per acre, heavy grain. The winter barley is sown in September, cut in July; yield about 30 bushels per acre, good grain.

IDAHO.—Only one report from this Territory, which is Mensury barley, sown in April and cut August 15; yield 71 quarts from 1 quart seed—rate of 63 bushels per acre; superior to any ever seen here.

POTATOES.

The Department of Agriculture, during the past year, has distributed throughout the country six new varieties of Irish potatoes (*Solanum tuberosum*), reputed to possess, among others, three superior qualities, viz: Earliness in maturing, quantity of yield, and delicacy for the table; they are the Victor, Alpha, Ruby, Beauty of Hebron, and Clarke's Nos. 5 and 6. Reports received from experimenters have very generally proved the correctness of the merits claimed for these tubers, and have shown varied successes with the different varieties in different localities. Numerous statements have been received from different States, assuring the department that the benefits realized from the distribution of these improved tubers are alone very great, and exceed in value the entire annual appropriations for the department.

ALABAMA.—In this State the Beauty of Hebron is reported as ripening earlier than Early Rose, every way equal in quality, and more productive in yield, ranging from 10 to 50 fold for 1 planted. Nearly equal results are reported for the other varieties. One important lesson is noticeable in returns from this as from most other States, namely, that best results are uniformly obtained, both in quantity and quality, from well-drained, deeply-plowed land. The earliness or dates of ripening is reported as taking place at quite different periods at different points, not only with the different varieties, but with the same variety under different hands, ranging in length of time from 65 to 120 days from date of planting. Beauty of Hebron planted March 8 ripened in 90 days; yield, rate of 317 bushels per acre; equal to the best in quality. Victor ripened in 115 days; yield, 252 pounds for 4 pounds planted; flavor good. Alpha and Ruby, early, light yield, but good quality. No. 5 yield 300 pounds for 16 pounds planted; extra good quality; not quite so early.

MAINE—Reports that Beauty of Hebron, planted May 4, showed vines luxuriant; ripened in 100 days; is earlier than the Early Rose; yield light; tubers good size, smooth, and excellent for the table.

NEW JERSEY—Reports Victor, planted April 22, ripe in 110 days; yield 30 for 1; not very good. Alpha, planted same date, earlier than above; yield less, but better for table. Beauty of Hebron about same as above. Another report: Victor bloomed June 12; ripe in 80 days; yield 80 pounds for 1 quart planted; not as good to eat as Early Rose. Alpha, ripe in 70 days; yield light, but quality equal to Early Rose, and better than Victor. Beauty of Hebron, planted May 14; blossomed June 19; ripened early; yield, 75 pounds for 1 planted; flavor equal to Early Rose. One report says the Breese No. 4 is equal to any sent out by the department. Another report: Victor planted April 20; ripe in 117 days; yield very large; quality mealy and good. Ruby, planted April 20, ripe in 90 days; yield fair; tubers mealy and good. Beauty of Hebron, planted April 20; ripe in 100 days; yield large; tubers fine and good. Clarke's No. 5, planted April 10; dug August 28, yield 9 pecks from 1 quart; very good.

PENNSYLVANIA—Reports the Victor, planted April 30, dug July 27; yield fair, quality good. Alpha not quite equal to Early Rose in quality or yield; small tubers; fair for table. Ruby, fair, small yield, not quite equal to the above. Beauty of Hebron, planted May 1, bloomed July 8, dug August 20; yield 4½ bushels from 6 quarts; large, smooth, fine tubers, earlier than Early Rose. Another report: Victor, planted April 9, dug August 23, white and mealy, good flavor; yield, rate of 22,500 pounds per acre—about 370 bushels. Beauty of Hebron, planted April 9; ripe August 1; yield, 13,047 pounds per acre; (about 217 bushels) medium quality.

DELAWARE.—Beauty of Hebron reported to be earlier than Early Rose; excellent quality, and yield 26 fold for 1 planted; by Mr. Rosa, master State grange.

MARYLAND.—Victor matured before Early Rose; equal to the best; the Alpha, Hebron, and Victor gave tubers of size from 6 to 8 inches, long diameter; and the Hebron gave 25 good tubers on a single vine, doubling the yield of the Early Rose. Ruby, planted April 5, dug July 3; yield 267 pounds for 6 pounds planted; fine form, color, and flavor; same, ripe in 90 days from planting, and dug 4 bushels from 1 quart planted. Another report says: "Beauty of Hebron gave 6 bushels for 1 quart planted; the hills manured with hog's hair, the best fertilizer ever used." Another: 1 peck gave about 4 bushels large, fine tubers, but somewhat liable to rot.

VIRGINIA.—One report: Victor No. 1, planted March 1, 11 pounds seed; blossomed June 8, dug July 8; yield 290 pounds; dry, solid, good for table. Alpha, No. 2, planted March 1, 7 pounds; two-thirds rotted in the ground; no bloom; dug June 26; yield one-half bushel; boiled dry, and good for eating, but rot badly. Beauty of Hebron, planted March 7, 11 pounds of seed; bloomed June 5, dug June 26; yield 183 pounds; no rot; boiled dry and flaky; excellent for the table. Victor and Alapha planted in clay-gravel soil well fertilized, the Beauty of Hebron was planted in sandy loam well fertilized; one single vine from a single eye gave 4 pounds of tubers; 64 tubers weighed 60 pounds; the seed of all were cut to single eyes, planted in rows; the report says the Victor and Hebron are a valuable acquisition to farmers of Virginia. The Ruby ripens in 85 days; yield 408 pounds for 8 planted. Another report: Victor ripe in 95 days; yield 3 barrels fair tubers for 8 pounds planted. Alpha ripe in 85 days; yield

2 bushels for 6 quarts planted; fair tubers. Ruby ripe in 85 days; yield 2 barrels for 8 quarts planted; very good potatoes. Hebron, about same as above, rather earlier and tubers best of all. Another report: Victor gave 1 bushel for 1 quart planted; some of the tubers weighed 1½ pounds; pink skin and mealy. Hebron gave 355 pounds for 6 quarts planted, good quality; other reports about same, say less liable to bugs than others. Beauty of Hebron 91 pounds for 1 quart.

WEST VIRGINIA.—One report states Victor ripe in 90 days from planting; yield fair; tubers dry and mealy; best ever grown here. Alpha ripe in 70 days, very early, but flavor appeared rather strong. Beauty of Hebron ripe in 100 days; rank grower, good bearer, but not quite equal to the Victor. No other reports from this State on potatoes.

NORTH CAROLINA.—Report states the Alpha planted same day as Early Rose, but is much more forward, vigorous, and now (May 17) tubers big as hen's eggs. Another: All four varieties were planted 9 days after the Rose, but they came forward earlier, with fine tubers. One other: Ruby, planted February 20, cut down by frost on the 23d, on March 25 came up again; dug June 21; 248 pounds for 4 pounds planted. Another: Victor planted February 20, bloomed May 1; ripe in 100 days from planting; large yield and fine flavor for the table. Another: Beauty of Hebron planted April 1, bloomed May 1; ripe in 100 days from planting; the earliest of all; yield 510 pounds for 8 pounds planted; superior quality. Another says, not a good keeper.

SOUTH CAROLINA.—Reports state that the Victor and Alpha are far ahead of Early Rose; good and rich; very fine for the table; large and nice. Another: Ruby, vigorous; blooms in 40 days, and ripe in 75 days from planting; yield prolific, 210 pounds from 1 quart of seed; excellent, and earlier than the Rose. Another: Beauty of Hebron the largest yield of all; good as any for the table; ripe in 90 days from planting. Another: planted 6 potatoes April 15; grew finely; yield 4 bushels, tubers fine flavor. Victor planted February 12; healthy growth; blossomed April 20, ripe in 105 days; yield, rate of 14,000 pounds per acre—250 bushels. Second crop can be obtained if planted early.

GEORGIA.—Report says all four varieties sent yield well, give good satisfaction, and more of them wanted. Beauty of Hebron planted March 9; ready for table May 1; yield larger than any other. One says Hebron ripened in 50 days. Alpha planted February 15, dug April 15. Ruby planted February 15, dug May 30. Beauty of Hebron planted March 1; poor yield and quality. One report says none of these excel the Early Rose. Another report declares them earlier than the Rose and superior to any ever grown here. One report says tubers of the Hebron weighed 5 ounces, and very fine.

FLORIDA.—The Victor ripens here in 65 to 90 days, yield ranging from 10 to 30 for 1 planted. Victor ripens in 60 to 100 days, yield surpassing all others; mealy and good, equal to the Early Rose. Alpha earlier than Victor; delicate; not so prolific; some rot. Ruby about same as above, more prolific, and no rot. Beauty of Hebron planted March 7, ripens July 1, yield best of all, and superior for table. Hebron grew well and yielded abundantly. November best time to plant potatoes here.

MISSISSIPPI—Reports all four, Victor, Alpha, Ruby, and Beauty of Hebron, healthy, early, prolific, and well suited to this climate and soil, but Victor preferred. Another: Ruby the earliest and best for table. Another: Alpha earlier than Victor and finer flavor. Another: Beauty of Hebron planted February 26, bloomed April 20, ripe in 90 days, yield larger than any other; this and others a great acquisition, and thanks to the department for them. Another: The best ever grown here; early, thrifty, and good flavor. Hebron gave 54 pounds for 1 planted; excel all others here. One report says second plantings generally fail.

LOUISIANA.—One report from this State say that Ruby is best of all in excellence; that Alpha is the most continuous bearer; Beauty of Hebron a vigorous grower; Victor ripe in 90 days after pladting; yield about same as Hebron.

TEXAS.—Reports show the four varieties sent out from the department are improvements on those commonly planted; Victor, vigorous, bloomed April 20, ripe in 95 days, yield twice as much as Early Rose, 350 pounds for 8 quarts planted, mealy and good, purple skins; Alpha, foliage more delicate, yield 115 pounds for 7 quarts planted, mealy and fine flavor; Ruby, planted February 11, dug on May 2, yield 24 pounds for 2 pounds planted, smooth thin skin, best of the three; Beauty of Hebron, grew vigorously, bloomed in 50 days, and ripened in 90 days from planting, yield 400 pounds from 8 quarts seed, mealy and fine for the table, about 34 for one.

KENTUCKY.—One report: All the potatoes sent out here by the department excel our common varieties grown here; Beauty of Hebron, planted in March 1½ pounds, in July dug 90 pounds very fine tubers. Another: 50 pounds from 1 planted; Victor, early, large yield, mealy, fine flavor. Another: 2 bushels from 2 quarts; Alpha, fit for table in 90 days, yield 1 bushel from 2 quarts; Ruby, reports about same as Alpha. One report says Victor ripened in 120 days, yield 371 pounds for 12 pounds planted; Alpha ripened in same time, yield 409 pounds, superior to all others; Ruby ripens in same time, yield 403 pounds; Beauty of Hebron ripened in 110 days, small yield, 167 pounds, not so good as the others.

TENNESSEE.—The Victor is the finest potato for the table ever grown here, yield moderate but early. Another: Yield 360 pounds for 6 pounds planted, good for table, was planted February 15, blossomed May 15, dug June 27; Alpha, dates same as Victor, yield 140 pounds for 3 pounds, very fine quality; Ruby, dates as above, and quality better than either; Beauty of Hebron, planted March 16, blossomed May 2, dug June 2, yield 256 pounds for 3 pounds, earliest and best of all for the table. These varieties have increased the potato crop in the State very largely; the Hebrons generally surpassing all others in yielding, quality, and earliness.

MISSOURI.—Victor planted March 18, ripe in 80 days, yield 85 pounds for 1 pound planted, best of all for table; Alpha, earliest of all, yield 25 for 1; Ruby, planted March 26, dug in 90 days, yield 378 pounds for 10 pounds planted; Beauty of Hebron, planted March 18, bloomed May 6, dug in 74 days, yield 379 pounds from 6 pounds planted, good and solid. Another: 300 pounds from 5 pounds planted. Thanks to the department for these superior potatoes. Another: Yield 3 bushels for 3 quarts planted, 10 days earlier than the Rose, superior in quality. Another: Planted 2 quarts April 1, and July 8, dug 70 pounds fine large tubers. Another: Planted in sandy loam, cut to single eyes 1 gallon, and dug 6 bushels fine large potatoes, being 256 for one planted. Clarke's No. 6, planted April 10, ripe in 95 days, from 3 quarts 150 pounds of smooth good table potatoes; one report says the Hebron beats the Rose and Peerless.

OHIO.—Victor, bloomed in 30 days from planting; ripe, 120 days; yield, 160 pounds for 4 pounds planting, and most excellent quality. Ruby, somewhat earlier; yield light, but good eating. Beauty of Hebron, ripe in 120 days; yield, 275 pounds for 8 pounds planted; largest and best ever seen here, and they cook nicely. Alpha, planted March 19, fit for table early in June; 3 weeks earlier than Early Rose; dry and mealy. Another: Victor, not so early as Alpha; is mottled purple and white; eyes rather sunken; tubers large, resembling Peach Blows, but of superior flavor; strong grower; yield large. Alpha, earlier than above; white, resembling Early Rose; but somewhat earlier; eyes more sunken; cooks well, keeps well, good flavor, and mealy; moderate bearer. Beauty of Hebron, earlier than the others, light yield, white, resembles Early Rose, very fine flavor, cooks nicely.

ILLINOIS.—One report on the four varieties states: Beauty of Hebron planted April 18, bloomed in June, dug August 29; yield, 330 pounds for 8 pounds planted; tubers large and good flavor. Victor, planted April 17, dug August 29; yield, 390 pounds for 8 pounds planted; excellent for the table. Alpha, planted April 17, dug July 24; yield, very light; good for early crop; delicate flavor. Clarke's Nos. 5 and 6, poor yield; hardly worth further trial. Another report: Hebron, planted April 27, dug August 29; rotted some; yield, 240 pounds from 5 quarts; quality good as Early Rose. Another: Hebron, planted March 23, ripe July 10; yield, large; quality better than Early Rose. Alpha, earlier than Hebron, but yields less. Victor, planted April 2, bloomed June 2; vigorous growth; ripe in 100 days; yield, 528 pounds for 6 pounds planted; excellent quality. Clarke's Nos. 5 and 6 not reported in detail; says one resembles Early Rose, and is good; the other gives small yield.

INDIANA.—Planted Victor March 23; ripe in 65 days; yield, 422 pounds for 8 quarts planted; tubers bluish color, good and mealy. Alpha, planted March 23; ripe in 60 days; tubers small and white; yield, 71 pounds from 3 quarts planted; delicate and good. Beauty of Hebron, planted March 3, 2 quarts; ripe in 60 days; yield, 83 pounds for the seed planted; pink color, large, and very good. One report says they are not first rate, and that they have better.

MICHIGAN.—Planted Beauty of Hebron in April; blossomed in May; ripe in 75 days; dug 180 pounds from 6 pounds planted; quality good. No others reported from this State.

IOWA.—One report: The Beauty of Hebron is a good potato, dry and mealy; earlier than the Early Rose.

MINNESOTA.—Alpha, ripe in 80 days from planting; small yield, but quality excellent; some rotted; earlier than Hebron. Beauty of Hebron ripe in 90 days; yield large and of good quality. Another report: Hebron gave 130 pounds for 6 pounds planted; large, smooth, and handsome. Clarke's No. 6, planted April 15; ripe in 90 days; yield, 80 pounds from 6 pounds planted; good flavor, but does not cook dry. One report: Snow-flake best of all.

KANSAS.—Reports Beauty of Hebron planted April 26; bloomed June 10; ripe August 14; yield, 548 pounds for 8 pounds planted; tubers large, mealy, good; earlier and better than Early Rose; does well on wet and dry land. Ruby, planted in March, thrifty foliage, no bloom, ripe August 1; very dry, good, and better than Early Rose. Another: Hebron, planted April 19; dug July 24; yield, 60 for 1; tubers white as snow, mealy, fine flavor. Victor, planted April 10; dug August 14; large yield; finest tubers ever seen; could not be better.

ARKANSAS.—Reports upon the four varieties, much the same from this State as from Alabama. One report: Beauty of Hebron, planted March 1; bloomed May 1; yield, 200 pounds for 1 pound planted. Victor ripened in 70 days; yield, 150 pounds for 1 pound planted; splendid tubers. Other reports with the above varieties represent

them ripening in from 115 to 136 days, and giving yield of 10 to 100 fold for the quantity planted. One report: Hebron ripened in 120 days; yield, 250 pounds for 6 quarts planted; quality, earliness, and yield equal to best Early Rose, and finer shape. The Alpha and Ruby are reported as early, excellent quality, but generally giving a lighter yield and more delicate growers.

CALIFORNIA.—Victor planted in February, bloomed early, ripe in 100 days; yield moderate; very good for the table; tubers large. Alpha, early; yield light; tubers small but good quality. Ruby, early; yield large; good size, and fine for the table; some rot. Beauty of Hebron rank grower; ripe in 100 days; tubers large, smooth, and healthy; yield, moderate; quality fair; not so dry as some.

OREGON.—Victor planted April 13, bloomed June 15, dug August 1; yield, 194 pounds for 2 quarts planted; quality good. Alpha, planted May 7, grew a short time, then blighted, dried up. Beauty of Hebron, planted April 13, blooms freely; dug July 29; yield rate of 200 bushels per acre; mealy and solid for the table. Another says: These potatoes are a great acquisition from the department, and should be distributed throughout the whole country.

COLORADO.—Beauty of Hebron, in Ouray County, planted May 30 on western slope of Engineer Mountain, 7,500 feet above the sea-level; frost September 10; yield from 4 quarts 193 pounds; white, mealy, and most delicious tubers.

DAKOTA.—Clay County reports the Beauty of Hebron the earliest and best potato in that Territory, surpassing the Early Rose.

WYOMING.—Laramie County reports Ruby, 4 quarts planted, dug 220 pounds excellent tubers. Hebron about the same as Ruby only white and more dry.

From this testimony it is clear that the yield of this tuber has been greatly increased in nearly every State by the introduction of these six new varieties.

BUCKWHEAT.

ILLINOIS.—Reports show very little buckwheat sown in this State. One report says 2 quarts sown July 3 yielded 5 bushels good, plump grain. This grain (*Polygonum agopyum*) was originally called beechwheat from the resemblance (3-cornered) to beechnuts.

VERMONT.—In this State the Silver-hull buckwheat is reported as giving great growth of straw but little grain.

OHIO.—Only one return received from this State, and it says that the Silver-hull buckwheat does well here.

MICHIGAN.—One report from this State says the Silver-hulled buckwheat succeeds well; from 2 quarts of seed 4 bushels of good grain was obtained.

WISCONSIN.—Reports show that both the silver-hull and Tartarian varieties yield well of good grain in this State.

IOWA.—The Silver-hull buckwheat is reported as giving good yield among experimenters here.

KANSAS.—Silver-hull buckwheat is reported as doing admirably well here; yields largely and stands the drought better than other varieties; 24 bushels the acre of grain weighing 52 pounds the measured bushel is reported.

PENNSYLVANIA.—In this State Silver-hull buckwheat is reported as succeeding well, productive, and very desirable.

COTTON.

LOUISIANA.—Of the several varieties of cotton seed, distributed by the Department of Agriculture to this and other States, reports from here state that the McClendon Mammoth is the most prolific and gives the finest quality of staple of any planted in this vicinity.

MISSISSIPPI.—One report, on the results with the Mammoth Prolific, states that it was planted on clay soil, May 1, 4 quarts seed—and nearly all germinated, grew, and stood up well, giving 80 pounds seed-cotton and 25 pounds lint for the seed sown; the staple longer than common, of a rich, cream color, and easily picked; it is in all respects a good, superior variety.

TEXAS.—One party reports that Myer's seed, received from the department, is preferred for its large bolls and for standing up well. Another reports that the Mammoth Prolific, from the department, is the best for Texas. Another reports that the Mammoth Prolific, planted April 26, on black land—700 square yards—gave 930 pounds of seed-cotton, of good quality, 60 bolls weighing 1 pound; this is reported here to give the largest yield of any of the five varieties sent from the department.

AMBER SORGHUM.

MISSOURI.—*McDonald County:* Reports that of the Amber Sorghum seed a small portion only germinated—the stalks grew small, but made double the quantity of sirup of other varieties.

TEXAS.—*Coleman County:* One report says the Minnesota Amber Sorghum, from the department, proved a good success—the stalks being smaller than others—makes clearer sirup and yields larger percentage of sugar; says one pint of air-slacked lime put into one gallon of raw juice and stirred into 40 gallons, as it begins to thicken, will cause it to granulate.

KANSAS.—*Allen County:* One report: Obtained 47 gallons per acre; very fine quality.

FLORIDA.—*Orange County:* Reports that it grows 10 feet high and gives large yield of fine sirup.

MISSISSIPPI.—*Attala County:* Reports the seed from the department planted in April; manufactured in August, and gave about 25 gallons of sirup from quantity of seed planted sent from the department, and of excellent quality.

ILLINOIS.—*Will County:* Reports, from 18 square rods of land, he got 15½ gallons of good sirup, weighing 12 pounds per gallon.

SUGAR BEETS.

MAINE.—*Cumberland County:* Reports from here show that from the Sugar-Beet seed, distributed from the department, the farmers succeed in growing them, and get $4 per ton for them at the nearest depot; but state that it does not pay for raising. The yield of sugar, by the operations at the factory, is 13½ pounds for 100 pounds of beets. *Saco County:* Reports 17 to 20 tons of beets obtained from an acre. *Knox County:* Reports that one party got 26 tons per acre, planted May 20, on gravelly loam, and gathered last of October, at a cost of seven cents per bushel. *Lincoln County:* Seed received and planted, did well, and is a good acquisition. *Franklin County:* Reports them a profitable crop for stock.

NEW HAMPSHIRE.—*Rockingham County:* One party reports the sugar beets, planted May 15, yielded 19½ tons per acre. Another reports 200 pounds from ten square feet of soil, and an indispensable feed for stock. Another report: They are superior to all others.

NEW JERSEY.—*Cumberland County:* Reports that they are prolific and suited to the climate and soil. *Monmouth County:* Reports 400 bushels per acre, and a superior variety.

FRUITS, AND FOREST-TREE SEEDS AND SHRUBS.

KANSAS.—From *Ellis County* report says the fruit and forest tree scions and seeds sent from the department are doing well; the locust was planted and is well up and growing. *Rice County* reports the cranberry-plants sent as successful.

NEBRASKA.—From *Kearney* and *Polk Counties* reports say the evergreens, larch, &c., are growing rapidly, but that the ailantus winter-killed. *Hall County* reports the Russian apple-scions were grafted on good stock and nearly all grew well; some of them made 2 to 3 feet growth in the season. Also the berry-bushes, of every kind distributed here by the department have done well, and are regarded as valuable.

MICHIGAN.—Report from *Emmett County* states that the cherries, peaches, and plums received from the department are doing well, and appear to be adapted to the locality.

OHIO.—*Hardin County* reports that the grapes, persimmons, and strawberries from the department have done well and are thriving.

IOWA.—*Jasper County* reports that the fifty-two apple-scions of Russian varieties were all successful and promise valuable results, and that the grape-cuttings are alive and good.

MINNESOTA.—From this State reports represent the apple-scions sent from the department as being very generally successful and valuable.

ARKANSAS.—Only one report from this State; says that fourteen of the Russian apple-scions are alive and doing well; a few of them have already fruited, and give very good apples.

TOBACCO.

The department has distributed seeds of five varieties of tobacco, viz, Yellow Orinoco, Silky Prior, Broad-Leaf Orinoco, White Burley, and Vuelta de Abajo (a Havana variety of seed). Not many reports of results have been received, but those which have come to hand indicate that these varieties of seed have generally done well.

ALABAMA.—From this State one report says the seed did very well and is useful; another says the White Savannah was a failure for want of proper planting and care of seed-bed.

ARKANSAS.—One report from here says the Orinoco is good and resists the worm; the Silky Prior is also good. Another: All the varieties succeed except the White, which "grows too rapidly." Another: Orinoco did far better than the White or Silky Prior.

GEORGIA.—One report: Seed came too late to plant this season; will try it next spring. Another: Gave tobacco-seed to freedmen and they made good crops.

IOWA.—Reports that the Connecticut seed-leaf does well here, but that the White Burley and Havana do not.

KENTUCKY.—White Burley, large plants, superior quality, does better and is better suited to this climate than Havana or Orinoco.

MISSOURI.—Orinoco grew finely, but did not mature well; white succeeded much better. Another: Orinoco and White, both made a good crop and yield well, but the White generally best. Another: Silky Prior, Orinoco, Havana, and Broad-Leaf, were planted; the first three named doing best, and most suitable to this locality.

OHIO.—Only one report. Very few of the seeds sprouted, and got but few plants; they were good; no name of variety given.

NORTH CAROLINA.—White Burley does better than any other grown—makes broad leaves two feet long and fine wrappers. Another: the seed from department very fine. Another: Orinoco planted May 1, cut last of August, made 600 pounds per acre—considered a valuable acquisition here.

SOUTH CAROLINA.—One report says the dark seed was successful, the white a failure; thinks the soil unsuitable.

TENNESSEE.—One report, without naming variety, thinks it a superior kind. Another: White, Silky Prior, and Orinoco Broad-leaf; the first two very fine, curing up beautifully; the last not so good.

TEXAS.—Connecticut Leaf came up well and yielded largely; White Burley nearly as well; coast tobacco turned out poorly. Another: planted and came up, turned out badly by reason of drought. One report from Lavaca County says the tobacco seeds—Havana and Oronoco—received from the department are very good, early, and just the kinds for this section; Havana is the earliest, but Oronoco has the largest leaves.

MISSISSIPPI.—From Marshall County the report states the Oronoco did well, and is very good; also that the White succeeded, but was more injured by insects than others.

TEA PLANTS AND SEEDS.

This department distributed both tea plants and seeds to different States, and reports therefrom show general successes with the plants; but less with the seed, which frequently failed to germinate.

MARYLAND.—*Baltimore County:* The tea-plants received here are reported as doing well.

NORTH CAROLINA.—*Polk County:* The tea-plants were receive ; those set out in the "thermal belt" are all doing well; but those set out near the house nearly all perished in consequence of dry weather.

SOUTH CAROLINA.—*Union County:* The tea-plants succeeded well, and we are *drinking tea of home production. Darlington County* reports the plants growing, but not very flourishing on account of dry weather—hot weather blights them. *Sumter County:* The plants are alive, but suffer from drought.

GEORGIA.—*Henderson County:* Tea-seed received and planted, but did not germinate.

ALABAMA.—*Logan County:* Reports from this county state that the tea-plants were received from the department and are alive and thrifty.

FLORIDA.—*Sumter County:* Reports plants received and growing well.

MISSISSIPPI.—*Lafayette County:* Tea-plants received, are alive and thriving.

TEXAS.—*Nacogdoches County:* Reports the tea-plants received as doing well there. *Milan County:* Tea-seed received and planted, but very little of it came up. *Burnett County:* Seed received, portion of it germinated, but the young plants soon died from hot, dry weather; similar results reported from *Washington County.*

LOUISIANA.—*Vermillion Parish:* Reports the tea-plants received and growing finely; will succeed well here, and are entitled to general cultivation in this section.

IOWA.—*Mills County:* The tea-plants received, and are alive and growing.

CALIFORNIA.—*Butte County:* Seed received and planted, but failed to germinate.

VIRGINIA.—*King George County:* Plants reported as received, but killed by the first *frost* in the fall. [This cannot have been the cause of failure, as the tea-plant resists most equally as well as the privet or the currant bush.]

The *lesson taught*, almost universally, by the reports of these experiments, corresponds with what we learn from other intelligent sources in regard to the needs of the tea-plant, in order to secure luxuriant growth, namely, *plenty of moisture* seems necessary, by irrigation or otherwise; care being taken, at the same time, to avoid wet, soggy land, and to provide shade from hot sun-rays, until the plant is large enough to protect its roots.

PREFATORY TO REPORTS OF HEADS OF DIVISIONS.

If the appropriation for the publication of the annual report of this department could be made available on the 1st of January of each year it would be possible to print and distribute the report of the preceding year before the adjournment of the regular session of Congress; but as the appropriation is not now available until the beginning of the new fiscal year (July 1, 1879,) the annual report for 1878 cannot be printed until that time, and will be distributed by members of Congress during the succeeding session, in the winter of 1879–'80; hence it is possible, and sometimes desirable, to include in the report of the previous year the work done in the spring of the year following. In this report of 1878, so called, much important work of the Chemical Division, under the able and earnest direction of the chemist, Prof. PETER COLLIER, has been accomplished during the year 1879; and the same statement will apply to the article on "Diseases of Domesticated Animals," carefully compiled by Mr. W. J. COWING from the reports of experts employed as examiners.

The work of the department has been brought down to the latest day possible in these cases, because the matters under examination were specially interesting and important to the country at large; and all the information that could be contributed to the subjects treated was earnestly desired and sought for by very many correspondents.

It is a subject of much regret that the Chemical Division is so limited by insufficient means, as well as for the want of a proper laboratory, that much work, particularly analyses of various mineral deposits referred by members of Congress and agricultural and scientific associations, could not be accomplished; but an examination of what has been done will satisfy any one familiar with the facilities afforded that there has been no waste of the space, time, or means at our disposal. Among the minerals that have been analyzed are specimens from nearly every section of the country, many giving evidence of the existence of valuable mineral deposits which warrant a more thorough examination. It has been the desire of the department to assist, so far as it could be done without interference in our regular work, in the development of all the mineral resources of the country, including the ores of all metals as well as the minerals of value only as fertilizers.

Detailed results of these examinations have been omitted, as the report, by the law making the appropriation to print, is confined to a limited number of pages.

EXPERIMENTS IN SUGAR-MAKING.

During the past year experiments have been made in the manufacture of sugar from corn-stalks and sorghum, and the interest manifested in the results has been shown by the examination of the sugars produced by many hundreds of spectators, and by letters received from every section of the country showing anxiety for information concerning the

matter, as also by a pretty general discussion of the subject by the newspaper press of the country. In view of the magnitude of the interests involved, and the possibility that in the place of an annual importation amounting to from $80,000,000 to $100,000,000, we may within a few years not only produce sufficient sugar for our own wants, but become one of the sugar-exporting countries of the world, it is therefore not surprising that this feature of our work the past year should have partially overshadowed the remainder. While everything has been done that would seem possible under the circumstances to obtain accurate results of this important investigation, yet with very imperfect apparatus and inferior material the experiments must be acknowledged to be as yet incomplete.

Many practical questions will at once suggest themselves to which the experiments of the Chemical Division afford no precise answer, and we must wait, with the hope that during another season we may obtain more full and satisfactory replies to most of these undetermined questions, among which may be mentioned the following:

1st. What variety of corn or sorghum will give the most sugar to the acre?

2d. What time of cutting gives the best results?

3d. What soil and mode of culture is best adapted to the production of sugar?

4th. What meteorological conditions affect favorably or unfavorably the growth of corn, sorghum, or allied plants, for purposes of sugar-making?

These, with other like questions, it is hoped may be partially answered the coming season, and that satisfactory progress may be made toward the attainment of the object in view, namely, the production of our own sugar.

That it is quite possible that with certain varieties of corn cultivated in some localities sugar may be made with ease by care and skill with the ordinary process of expressing the juice and reducing the same, without the use of chemicals, is apparent from several letters received upon this subject. It is not necessary to cite more than two or three instances. Mr. B. F. Taylor, of Victoria, Knox County, Illinois, forwarded to the department a sample of sirup, which, when received, was found to be more than half crystallized, and in reply to an inquiry as to the details of the manufacture of the sirup, sent the following letter.

It will be observed that he entirely dispensed with chemicals, and in many details differed from the method pursued in the experiments made at this department, which fact adds interest and encouragement to the subject under investigation. The letter referred to is as follows:

DEAR SIR: Your favor of April 29th is before me, and in reply to your questions I would say:

1st. Ground was a rich prairie loam; has been twenty years under cultivation. The rotation was corn, oats, wheat, barley, timothy, and clover. No manure for ten years. For the last four years it has been in timothy and cut for seed.

2d. Trench plowed 8 inches deep; seed planted by hand, 3½ feet by 20 inches, five seed to the hill. This cane has never suckered with me. Planted June 10th; plowed three times with two-horse cultivator. Hoed twice while small.

3d. Cut from 15th to 20th of September; seed had been ripe for some time. The stalks lay in a large pile in mill-yard nearly a month—fully three weeks. Stalks when cut showed a light golden color.

4th. Used a three-roller iron mill and two-horse power. As to the per cent. of juice, I cannot say, as we have no means of weighing either. I had half an acre of cane, and had 115 gallons of such sirup as I sent you. Five stalks were stripped and topped to the second joint while standing in the field, and they were cut and hauled immediately. The juice, after crushing, was run into a vat, and from there pumped into a heater and brought almost to the boiling point, keeping it skimmed the while. After

it would give off no more thick, green scum, it was run into the evaporator proper, which consisted of cast-iron pans on rollers. The pans were 8 feet long, 2½ feet wide, and 6 inches deep. They were kept boiling and skimmed constantly until no more scum would rise. To prevent burning, it should be repeatedly stirred with a broad wooden ladle. No lime or chemicals were used. The degree to which the sirup is boiled is determined by no fixed rules. One man who has had years of experience does the work, and can tell when to run off by taking it up on his ladle and then running it back into the pan. As soon as done the pan is rolled off the fire and the sirup is taken out and put into a cooler pan, and then run back and refilled. One heater will keep four such pans running.

Some say, boil it down thick so the sirup will keep; others say, do not make it so thick as I did last year, for we could not get it out of the barrel. Mine was boiled down so thick that after getting thoroughly cold it took an hour to run a gallon into a jug through an inch funnel. Granulation began within two weeks.

Besides the work of the Chemical Division herein reported, there has been received almost daily letters from all sections of the country asking for advice and information concerning the various matters pertaining to agricultural chemistry, and the correspondence alone is no inconsiderable item of the work devolving upon this division.

TANNING MATERIAL.

The importance of a new and abundant source of tannin can hardly be overestimated. While in the oak and hemlock bark and sumac of the country the United States will probably have enough tanning material to answer their own purposes for the next generation, yet there is a large market in other countries, which is now supplied from very many sources, involving the expenditure of millions of dollars. If it is possible to add to our agricultural exports a substance which can be produced at a profit, and command any considerable portion of the world's market for tanning materials, it is well worthy an effort on our part to secure, either by importation or naturalization of foreign plants, such as the wattle, or to utilize any that are native within our own borders for this purpose. The utilization of the sumac, which grows wild over so large an extent of our country, has been encouraged by a thorough examination made by Dr. McMurtrie, a former chemist, and being published in our last report has attracted very great attention throughout the country, and has given an impetus to the utilization of this bush, which is a common growth by the way-side and in neglected and abandoned fields.

A clearing out of the rooms devoted to the Chemical Division of the department incident to the induction of our present chemist disclosed, among other things which had been stowed way, evidently for years, the following correspondence, accompanying a parcel which apparently had never been opened. As there is strong probability that the root inclosed in this package will prove to be of great importance, the entire correspondence connected therewith is cited in this report:

SAN ANTONIA, TEX., *July* 9, 1868.

SIR: I have the honor to hand you herewith a copy of a letter written by John James, esq., of this city, in relation to the roots of the plant cañaigre, a package of which will be forwarded by the same mail that brings you this letter. The plant is found growing in the vicinity of Fort Clark, on the banks of Limpia Creek, and can be cultivated to any extent in Western and Northwestern Texas, where it sometimes grows to the thickness of a man's leg.

Any quantity of hides can be obtained here, and many thousands are shipped north, and manufactured leather is returned to the State. If all that is claimed for the cañaigre is true, it is destined to effect a great change in the leather trade of Texas.

Respectfully,

S. P. GAMBIA, *Postmaster.*

HON. COMMISSIONER OF AGRICULTURE,
Washington, D. C.

SAN ANTONIO, TEX., *June* 28, 1868.

DEAR SIR: I hand you with this letter a bag containing a quantity of dried bulbous roots of the plant cañaigre. The chemist, F. Kaltyre, of this city, says that these roots contain 32 per cent. of tannic acid in its natural state (dried), while the imported extract of catechu of commerce has only about 40 per cent. of tannic acid. This root has no gallic acid in it, which is very objectionable as a tanning agent.

Mr. Kaltyre did not analyze it with a view of ascertaining the presence of other foreign matter particularly, but only to ascertain the exact proportion of tannic acid, which he pronounced more powerful than any other known agent in its natural state. Will you please forward this root, and have determined if the plant be as valuable as represented? It can be cultivated very cheaply in this climate. It is a native of Texas.

Yours, very respectfully,

JOHN JAMES.

S. P. GAMBIA, Esq.

A letter similar to the above was, by Mr. Gambia, addressed to Professor Joseph Henry, of the Smithsonian Institution, together with a letter from Mr. James similar to the above, and accompanying these letters a second parcel of the roots was also sent, which parcel, together with the letters above referred to, were submitted to the Department of Agriculture by Professor Henry, with the following indorsement:

Respectfully referred to the Agricultural Department, with the specimens (in one small bag).

JOSEPH HENRY, *Secretary.*

Since the letter to Professor Henry differs in some particulars from the statements above given, the letter is reproduced:

SAN ANTONIO, TEX., *July* 15, 1868.

SIR: It is now some days since I forwarded by mail a package of 64 ounces of the dried roots of the cañaigre plant, used to some extent by the Mexicans in tanning hides. I addressed the package to the "Smithsonian Institute, Washington, D. C."

These roots were found in the vicinity of San Elizario, county of El Paso, Texas, where they grow abundantly without cultivation. They were also seen growing on the banks of the Lympia, a stream in the vicinity of Fort Davis, Western Texas. I inclose for your perusal a copy of a letter I received from John James, esq., of this city, at whose instance I forwarded the package of cañaigre roots. He wishes to have the roots fairly tested by some of your Washington chemists, and a report made if they are found to be of value, as it may save us the necessity of sending hides north to be tanned, if these roots can be used instead of the barks in use at the north for tanning leather. Vast quantities of hides are shipped annually to the north to be tanned that possibly may hereafter be tanned here, as the roots of the cañaigre plant can be raised to any extent in Western Texas, where the beeves are killed.

At San Elizario a Mexican was found tanning skins with the cañaigre root, and I am informed that in the interior of Mexico the primitive settlers are in the habit of using this root in dressing hides. I suppose the cañaigre root can be grown at an expense of about one cent a pound in Northwestern Texas, and transported to the sea-coast at say two dollars the hundred pounds.

Very respectfully, &c.,

S. P. GAMBIA, *Postmaster*

Hon. JOSEPH HENRY,
Secretary Smithsonian Institution, Washington, D. C.

An examination of these specimens, now over eleven years old, confirmed the great value of this new source of tannin, as will appear in the chemical analysis. Correspondence was entered into with those in the vicinity referred to, and a quantity of the fresh roots obtained, some of which were subjected to analysis, and the remainder were planted with a view of developing the plant and determining its botanical relations.

After a thorough examination of these specimens of cañaigre had

confirmed the great value of this new source of tannin as will appear in the analysis given, effort was made to obtain some of the green root in a fresh state, but as there were no funds available which could be used to pay the expenses of an agent to examine this subject thoroughly upon the ground, and hunt up the botanical history of the plant upon its native soil, there was nothing left for the department to do but to correspond and endeavor to obtain such information as possible through correspondence with persons living in the vicinity where it was said to grow. As this region is unsettled and in an almost wild portion of Northwestern Texas, in which the department had no regular correspondents, it was not until after some months that we were able to obtain by mail a small package of the green roots and an imperfect history of its growth. Some of these roots were subjected to an analysis, and the results fully confirmed the former examination made with the dried material. The remainder was planted with the view of developing the foliage of the plant, and determining its botanical relation. It proved to be a Rumex, but the exact determination requires further development than we have been able as yet to obtain from the plants grown in our propagating beds.

Such efforts will be continued as are possible with the limited means at the command of the department to obtain enough specimens of the seed of this remarkable plant to make a fair experiment in its cultivation and utilization, to the analysis of which the particular attention of those to whom this subject will prove of especial interest is called. In furtherance of an increased acquaintance with the tannin-producing plants of the world which may probably be grown with success in our own country, an interesting article upon the cultivation of the "wattle" for its bark, which is the chief source of tannin in Australia, has been prepared, and is published in this report as additional information upon this important subject.

WILLIAM G. LE DUC,
Commissioner of Agriculture.

REPORT OF THE CHEMIST.

SIR: I have the honor to submit the following report of the work of the Chemical Division of the Department of Agriculture during the past year:

The work may be summarized as follows:

1. Examination of minerals, including calcareous, phosphatic, and gypseous marls, rock phosphates, &c.; and assays of ores of the various metals (184 specimens in all).
2. Analysis of porcelain clay (2 specimens).
3. Analyses of mineral, spring, and well waters (12 in number).
4. Analyses of soils (11 in number).
5. Analyses of sugar beets (57 in all).
6. Analyses of cane, maize, and sorghum sugars (8 samples).
7. Analysis of beet sirup.
8. Analysis of ash of maize sirup.
9. Analyses of ash of sorghum sirup (2 samples).
10. Analyses of sorghum sirup (5 samples).

11. Analysis of maize sirup.
12. Analyses of fertilizers, superphosphates, &c. (5 samples).
13. Examination of plants for narcotic poisons or other alkaloids (8 specimens).
14. Examination of deposit in spring-water.
15. Examination of peat to determine value as fertilizer and as source of paraffin or oils (3 samples).
16. Examination of cream-puffs for mineral and vegetable poisons, for the Board of Health of the District of Columbia.
17. Examination of adulterated tea for the Board of Health of District of Columbia.
18. Examination of Bologna sausage for mineral and organic poisons, for the Board of Health of District of Columbia.
19. Examination of "the nuisance" for the Health Officer of the District of Columbia.
20. Examination for mineral and organic poisons of sample of coffee, for the Health Officer of District of Columbia.
21. Examination of canceled postage-stamps.
22. Analyses of two samples of oleomargarine for committee of House of Representatives.
23. Analyses for the Treasury Department, including—
 a. Fourteen samples of Demerara sugar;
 b. A specimen of iron scale;
 c. A bottle of suspected compound.
24. Examination of postal cards for the Post-Office Department.
25. Examination of oil from tea-seed.
26. Estimation of tannin—
 a. In cañaigre;
 b. In balsamo-carpon;
 c. In sumac (*Rhus glabra*);
 d. In common docks (two species).
27. Analysis of covering of eggs of insects.
28. Analysis of so-called bombic acid.
29. Analyses of ash of sorghum, maize-stalks, and sugar-cane (6 samples).
30. Analyses of earth from niter caves (5 samples).
31. Analyses of quicklime (6 samples).
32. Analysis of baking-powders.
33. Examination of siliceous diatoms.
34. Analysis of shell of egg from hen dying of cholera.
35. Analysis of milk from cow sick with pleuro-pneumonia.
36. Analysis of yam.
37. Analyses of proximate constituents and of the ash of native grasses, including—
 a. Nine from Alabama;
 b. Twelve from Texas;
 c. Four from Georgia;
 d. Three from Wisconsin;
 e. Two from Illinois;
 f. Two from Mississippi;
 g. One from South Carolina.
 h. One from Department grounds.
38. Experiments in preparation of tea from leaves obtained from—
 a. Department grounds;
 b. North Carolina (4 lots);

c. South Carolina (4 lots);
d. Georgia (2 lots).

39. Experiments in the making of sugar from—
a. Sorghum;
b. Maize stalks,
c. Pearl millet;
d. Teosinte (*Euchlæna luxurians*);
e. Beets. (23 experiments in all.)

40. Examination of tea and coffee substitutes.(7 specimens).
41. Estimation of saponin in—
a. Quillaye;
b. Lignumvitæ.

42. Examination of arsenical wall-paper (4 specimens).
43. Proximate analyses of cereals, including—
a. Maize (32 specimens);
b. Pease (6 specimens);
c. Beans (6 specimens);
d. Wheat (15 specimens);
e. Barley (1 specimen);
f. Rye (1 specimen).

44. Proximate analysis corn-cob meal.
45. Proximate analysis brewers' grains.
46. Analyses of butter (6 samples).
47. Examination of coloring matter in cactus and coleus.
48. Examination of whisky for fusel oils.
49. Examination of steam food apparatus.
50. Analysis of so-called "coal economizer."
51. Analysis of coal ashes.
52. Examination of "fir sugar" (manna).
53. Analysis of California tobacco.
54. Analysis of "London purple," substitute for Paris green.
55. Analysis of gypseous marl from Florida.
56. Proximate analysis cañaigre.
57. Proximate analysis leaves and berries of *Ilex glabra* (Ink berry).
58. Proximate analysis of Florida moss (*Tillandsia usneoides*).
59. Proximate analysis of common boneset (*Eupatorium perfoliatum*).
60. Proximate analysis of damiana (*Turnera aphrodisiaca*).
61. Proximate analysis of reindeer moss (*Cladonia rangifernia*).
62. Examination of three samples of sweet-potatoes from Peru.
63. Analysis of native wine.
64. Analysis of hydraulic limestone.
65. Analyses of two samples of "alkali dust" from Yakima, Washington Territory.
66. Analysis of bat guano.
67. Analysis of sand used in glass-making.
68. Analysis of coal from James River, Virginia.
69. Analysis of slate-dust fertilizer.
70. Ash analysis, including—
a. Maize (6 specimens);
b. Pease (2 specimens);
c. Beans (2 specimens).

In addition to the above, there has been submitted to this division a large amount of correspondence in reference to matters pertaining to agricultural and technical chemistry, and almost daily consultations have been held with those who desired advice or information concerning various matters requiring a knowledge of chemistry.

EXPERIMENTS IN SUGAR-MAKING FROM CORN-STALKS, SORGHUM, ETC.

The following tabulated results of my experiments are valuable in this especially, that they were conducted quantitatively throughout.

The corn-stalks were from a common field-corn, said to have been a cross between a yellow and white. The ears had been plucked from the stalks and sold in our own markets as green corn some three weeks before the stalks had been cut and brought to me for the making of sugar.

The sorghum was a variety known as the Minnesota Early Amber. Both corn and sorghum were in a condition of vigorous growth when cut, the leaves being green. The seed of the sorghum was sufficiently mature to warrant its preservation, and indeed the last lot received shelled slightly upon handling. The sorghum had not been planted or cultivated so as to produce even a fair average in size, as will be seen by the results appended.

The mill made use of in expressing the juice was an old sorghum-mill of common construction, which, through previous use and misuse, had been rendered quite unfit to give satisfactory results. After most of our experiments below given were concluded, it was repaired, so that afterward its working was very much better, as will be seen by the subsequent results given further on.

The apparatus used in the experiments, besides a few barrels and pails for holding the juice, consisted of a copper tank of the following dimensions: four feet three inches long; two feet three inches deep; two feet three inches wide; a galvanized iron pan nine feet long, eight inches deep, three feet six inches wide. This iron pan was surrounded by a wooden frame of two-inch plank, so as to support the sides, and each pan was placed in brick-work with chimney, and so arranged as to permit a fire to be kept below it in direct contact with the bottom. In the case of the copper tank the flame played about the sides also, so as to heat the contents more rapidly. The galvanized-iron pan was such as could readily be constructed by any ordinary tinsmith or mechanic.

The copper tank was used for defecation with lime; the galvanized-iron pan for evaporation.

The process made use of in these experiments was in its essential features the one recently patented by Mr. F. L. Stewart, Murrysville, Westmoreland County, Pa., and which has been described in the report of the department for 1877.

The process in brief is as follows: After topping or stripping the corn or sorghum, it was passed through the mill, and when sufficient juice had been obtained it was heated in the copper tank to a temperature of 82° Centigrade—182° Fahrenheit. After the juice had reached this temperature there was added to it, with stirring, cream of lime until a piece of litmus paper dipped in the juice showed a purple or bluish-purple color. The heat was now raised to the boiling-point, and so soon as the juice was in good ebullition the fire was drawn, and a thick scum removed from the surface of the juice.

After a few minutes the sediment from the juice subsided, and by means of a syphon the clear liquid was decanted off, leaving a muddy sediment which was equal to about one-tenth to one-twentieth of the bulk of the juice. This muddy sediment was then drawn off by means of a stopcock, and filtered through a plaited-bag filter, and the clear filtrate therefrom was added to the liquid previously syphoned off.

The clarified juice, which, during the above operation, is not allowed to cool below a temperature of 66° Centigrade, or 150° Fahrenheit, was

now emptied into the evaporating-pan, and there was added to it, with stirring, a solution of sulphurous acid in water, until the lime present was neutralized, as was shown by the reddening of litmus paper when it was dipped in the juice. The evaporation was now hastened as much as possible, and the juice concentrated to a sirup at a boiling point of 108° Centigrade, equal to 226° Fahrenheit, or thereabout.

It was the intention to concentrate the sirup still more (to a boiling point of 112° Centigrade, equal to 235° Fahrenheit), but it was found impracticable to do so in the evaporator, as the danger of scorching it was great, over a naked flame which could not well be controlled.

When the sirup reached the density above indicated, it was drawn off into wooden tubs, the fire having previously been drawn from beneath the evaporator.

Owing to the fact that each successive lot of stalks was a new experiment, I was unable to wait for the process of filtration of the sediment from the defecator to be completed, and therefore in every case lost a portion of the juice, which of course could have been saved in a continuous process such as would be practically carried out. This will explain what is meant by the juice utilized, as compared with that obtained.

It was intended to have still further concentrated the sirups in a smaller pan of galvanized iron, so arranged that by a slide the heat could be instantaneously removed to prevent the scorching of the sirup; but before this pan was completed it was found that the several tubs of sirup were crystallizing, and they were therefore allowed to stand; and the sugar was obtained by pressing out the molasses by means of an ordinary screw-press, the mass of molasses and sugar from the tubs being inclosed in an ordinary grain-bag. The sugar thus obtained was very greatly improved in appearance by the addition of 5 or 10 per cent. of water, and stirring it into a mush, and again subjecting the mass to pressure, by which operation the adhering molasses was almost entirely removed, and the sugar obtained was, in the case of sorghum, nearly white, while in the case of corn it was of a rich golden yellow. I may add that in no case, either with corn or sorghum, did I fail to obtain satisfactory results in the way of crystallization, although, of course, the molasses still contains a very large percentage of crystallizable sugar, which will, at least in great part, be obtained by further concentration.

I omit mention of seven experiments with comparatively small quantities of corn-stalks and sorghum, only saying that the results obtained were such as to fully warrant the more extended experiments here recorded; and it is unfortunate that the value of these experiments is vitiated somewhat by the imperfect apparatus employed, as also by the inferior material, which, however, was all that was obtainable in this vicinity. It is greatly to be desired that another season may find the department amply equipped with all necessary means to carry these important questions to a complete solution.

The point which these experiments have fully settled is, that there exists no difficulty in making from either corn or sorghum a first-rate quality of sugar, which will compare favorably with the best product from sugar-cane grown in the most favorable localities.

The experiments here given clearly indicate the probability that sugar may be thus made at a profit, and it is desirable that nothing be spared in continuing an investigation giving such fair promise of success.

Results of experiments in the manufacture of sugar from maize and sorghum.

Number.		Pounds of raw stalks.	Per cent. of juice in raw stalks.	Pounds of juice used.	Specific gravity of juice.	Pounds of sirup made.	Per cent. of sirup in juice.
1	Corn-stalks, stripped and topped	2,353	25.29	520	1053	74	14.23
2	Corn-stalks, stripped and topped	2,769	23.91	597	1061	101	19.92
3	Corn-stalks (butt ends), stripped and topped	3,568	29.04	971	1053	142	14.62
4	Corn-stalks (top ends), stripped and topped	2,547	19.94	483	1050	65	13.46
5	Sorghum, stripped and topped	3,052	37.97	1,099	1057	146	13.29
6	Sorghum, stripped and topped	2,860	32.06	808	1057	135	16.71
7	Sorghum, topped, but unstripped	3,034	36.75	958	....	148.5	15.50
8	Sorghum (butt ends), unstripped	1,324	47.49	445	1059	73	16.41
9	Sorghum (top ends), unstripped	1,322	43.16	398	1057	58.5	14.70
10	Sorghum (butt ends), unstripped	1,240	41.49	346	1062	57	16.47
11	Sorghum (top ends), unstripped	1,126	34.09	291	1059	41.5	14.26
12	Sorghum, small stalks, stripped	963	56.20	538	1086	102	18.95
13	Sorghum, large stalks, stripped	515	58.55	299	1091	60	20.00
14	Sorghum, small stalks, stripped	1,623	55.87	781	1086	156	19.97
15	Sorghum, large stalks, stripped	1,549	58.01	711	1084	158	22.22

In the experiments made with corn-stalks the stalks were invariably stripped, the tops being cut off at about the second joint. The percentage of stripped stalks, leaves, and tops is given in this table:

	Per cent. of stripped stalks.	Per cent. of leaves and tops.
No. 1	67.57	32.43
No. 2	58.69	31.31
Nos. 3 and 4	67.46	32.54
Average	67.91	32.09

In those cases where the sorghum was stripped and topped the following percentage of stripped stalks and of leaves and tops was obtained:

	Per cent. of stripped stalks.	Per cent. of leaves and tops.
No. 5	72.67	27.33
No. 6	72.55	27.45
Average	72.61	27.39

On account of the trouble in stripping the stalks, experiments were made with stalks unstripped, the tops alone being removed, and these

experiments appear to prove that this troublesome operation of stripping may be avoided without any diminution of the amount of juice or of sugar obtained therefrom.

Below are the results obtained from stripped and unstripped sorghum, calculated to the raw stalks used.

By raw stalks is meant the stalks as they were cut in the field, leaves, tops, and all.

Condition of cane.	Average per cent. of juice to raw stalks.	Average per cent. sirup in juice.
Stripped sorghum (Nos. 5 and 6)	35.02	15.00
Unstripped sorghum (Nos. 7 to 11, inclusive)	40.60	15.47

From the above it will be seen that not only was an increased amount of juice obtained, but that this juice gave an increased percentage of sirup, and there appears nothing unusual in the treatment of this juice from the unstripped cane, nor was there any appreciable difference in the readiness of the sirup to crystallize, nor in the character of the sugar finally obtained.

Although perhaps further experiments are desirable before considering this point as settled, it would appear from the above that not only was stripping unnecessary, but that it really involved a loss in the amount of sugar to be obtained; at least the above results indicate a difference of twenty per cent. increase in product in favor of the unstripped cane. It is not improbable that the above result is due to the fact that the leaves in passing through the mill tended to fill up the interstices between the compressed cane, and thus prevented the expressed juice from flowing through between the rolls with the bagasse. In case of discoloration by action of moisture or other causes, it will, however, be advisable, and probably necessary, to strip the stalks.

Several experiments were also made with both corn-stalks and sorghum to determine the relative value of the upper and lower half of the stalks, with the results given in the following table:

Portion used.	Percentage of juice to stalks.	Specific gravity of juice.	Percentage of sirup in juice.
Corn-stalks, butt ends, No. 3	29.04	1053	14.62
Corn-stalks, top ends, No. 4	19.94	1050	13.46
Sorghum, butt ends, No. 8	47.49	1059	16.41
Sorghum, butt ends, No. 10	41.49	1062	16.47
Sorghum, top ends, No. 9	43.16	1057	14.70
Sorghum, top ends, No. 11	34.09	1059	14.26

It will be observed that Nos. 8 and 9 were the butts and tops of the same stalks, and were cut just after a rain, as were also Nos. 10 and 11, from which the rain had evaporated, and that the difference in yield of juice and sirup between butts and tops is nearly constant. The increase in specific gravity of the juice from butts over that from the top is also worthy of notice.

From the above table the conclusion from the average results is, that the proportion, by weight, of sugar in the lower half of the stalk is to the sugar in the upper half as follows; corn butts to corn tops as 159 to 100; sorghum butts to sorghum tops as 131 is to 100. As will be seen by reference to the first table, the stalks of both corn and sorghum in the above experiment were divided almost equally by weight into butts and tops, so that the above proportion fairly represents the pro-

portion of yield of sugar in the upper and lower half of the cane. There was a marked difference in the appearance of the juice as it flowed from the mill (that from the butts being lighter in color, especially in the experiments with corn), but after clarification no appreciable difference could be observed, nor was there any difference in the product except the quantitative one above mentioned, which was, however, a marked difference. Also, there was a marked difference in granulation in favor of the juice from the butts.

It is not improbable that a complete examination of the molasses obtained from these sugars may show a difference in composition, but at the present there has been no time to complete such analysis, and it seemed advisable no longer to withhold the report of what has been already determined.

Reference has been made to the very imperfect mill with which the juice was expressed in the above experiment. This will be obvious when we consider that both maize and sorghum contain a far greater per cent. of water even than we were able to obtain of juice, viz., from 75 to 85 per cent. of the weight of the plant; but it was thought best to continue the experiments even under these unfavorable conditions rather than lose a season which might be, at least, valuable in preparing us for work in the following one, under more favorable circumstances.

Some experiments were made with the mill which will illustrate the loss which, unquestionably, resulted. A small portion of millet (130 pounds of stripped stalks) was passed through the mill, and twenty-one and one-half pounds of juice obtained (equal to $16\frac{5}{10}$ per cent.). The bagasse was again passed through the mill without any adjustment of rolls (as that was then impossible), and seven and one-half pounds additional juice was obtained (equal to $5\frac{8}{10}$ per cent.) of the raw stalks. Besides, as was to have been anticipated, not only had we lost a large percentage of the juice, but it was altogether the better portion, *i. e.*, containing a much greater percentage of sugar. In this case the first portion of juice obtained from the mill had a specific gravity of 1.061, while the second portion had a specific gravity of 1.064. If now this difference in specific gravity of juice was proportional to the sugar contained in it, as is doubtless the case, the increase of juice obtained by the second pressure amounted to an increase of 37 per cent. over that obtained by the first pressure; and what was true of the millet operated upon was doubtless true of the sorghum and corn of the reported experiments Nos. 1 to 11 inclusive.

A similar experiment with a small lot of sorghum showed that 21 per cent. additional juice was obtained by again passing the bagasse through the mill.

These facts would seem to indicate a very important modification of the mills at present in use, viz., the introduction of an additional roller, which should subject the bagasse, as it passes through, to a repeated pressure, even if that pressure be no greater than that to which it has just been subjected.

But I am not left to conjecture what results would or might have been secured by a perfect mill, from these two small experiments above alluded to, with millet and sorghum; for at the conclusion of experiment No. 11 the mill was taken apart, and it was found that the bearings had been in some cases entirely worn away, so that no adjustment of pressure upon the rollers was possible. Upon providing new boxes a series of four experiments was made with sorghum, the results of which are given below.

This sorghum was fully ripe, had been cut several days before putting

through the mill, no green leaves were upon the stalks, and it was brought after several days of dry weather, so that the percentage of juice which it contained was comparatively low; but, as is shown by the specific gravity and its yield in sirup, the increased yield from the mill after it was repaired was most decided and satisfactory.

I give below the results obtained in the four experiments alluded to, Nos. 12, 13, 14, and 15. By reference to the first table, it will be seen that the average of juice obtained in experiments 12 to 15, inclusive, was 57.16 per cent. of the raw stalks, and that the percentage of sirup in this juice averaged 20.29.

The specific gravity of the juice averaged 1.087. We have, then, the result of a good mill, as compared with the one used in the first experiments, the following:

Mill.	Per cent. of juice unstripped stalks.	Specific gravity of juice.	Per cent. of sirup and juice.
Old mill	48.96	1.058	15.18
New mill	57.16	1.087	20.29

By comparing the percentage of juice obtained and the specific gravity of the juice in the first and last experiments, it will be seen that the former results are to the latter as 100 to 175; while if we compare the percentage of juice obtained and the percentage of sirup in the juice, the former experiments in their results are to the latter as 100 is to 156. This apparent discrepancy is due to the fact that when the latter experiments were made it was possible for me to carry the concentration of the sirup to a greater density than in the former cases, and hence a given amount of sirup in this latter case represents a far higher content of sugar than in the former; but these results clearly indicate that with a good mill results from 50 to 75 per cent. greater than those obtained in my experiments could be confidently relied upon.

The character of the maize and sorghum operated upon still remains for consideration. As has been already stated, the maize-stalks had been stripped of their ears three or four weeks before they were cut for the mill. It is much to be desired, and is contemplated in the further experiments, to determine whether this was the time when their content of sugar was at the maximum. It is by no means improbable that had they been cut when the grain had begun to form, and was still in its milky state, that the product of sugar would have been greater. At least further experiments are needed to learn at what time the stalk may be most profitable as a sugar-producing plant.

Certain experiments upon record seem to establish the fact that, for one variety of corn at least, that period when the kernel is in the milky state is the time when the content of crystallizable sugar in the stalk is at its maximum. But this needs the confirmation of further experiments, since it is a matter of great importance. It is also by no means improbable that by careful selection, varieties of maize may be grown far surpassing any now known as sugar-producing plants. At the present, as in the past, all efforts in the cultivation of maize have tended in quite another direction, and with results very highly satisfactory. There is good reason to believe that certain varieties of sweet corn may be found to yield a much greater amount of sugar than has been obtained from the common corn operated upon in the above experiments. (See Report Department of Agriculture, 1877, page 250.) But this remains a question

for future determination, if means shall be provided to carry the experiments thus far made to a satisfactory conclusion.

It is also to be observed of the sorghum used in the above experiments, that it was by no means of such quality as would give the best results. Owing to thick sowing in drills, it had not secured full development; and although further experiments are necessary to determine the methods of cultivation which shall give the best results in product of sugar, there can be no question but that these conditions were far from having been attained in the sample made use of in the above experiments.

From a lot of nearly three tons the best fourth was selected, and the average weight of these stalks was, after being stripped, almost exactly one-half pound each—195 stalks, by actual count, weighed 100 pounds—while the three-fourths remaining gave an average of 530 stripped stalks to 100 pounds. There is therefore no one, probably, who would hesitate to believe that with an improved mill, and with properly grown cane, results fully 100 per cent. better than these published could readily have been secured.

The experiment with millet, already mentioned, gave very interesting results, and promises to be a new sugar-producing plant of considerable value. In this experiment, 130 pounds of stripped stalks, of the variety known as pearl millet, were passed twice through the mill, the first yield being 21½ pounds of juice, of specific gravity 1.061, the second pressing giving 7½ pounds of juice additional, of specific gravity 1.064. The total result was an amount of juice equal to 22.3 per cent. of the weight of stripped stalks.

By the treatment of this juice by the process already described, 24¾ pounds of juice yielded 2¼ pounds of sirup, which speedily crystallized, yielding an excellent sugar, which polarized 92°.

The amount of sugar thus obtained in the first crystallization was fifteen-sixteenths pound, leaving a dark-colored molasses, which would doubtless yield an additional amount of sugar upon a second crystallization.

This experiment with millet, like those with sorghum and maize, was vitiated through the imperfection of the mill, but the character of the result attained certainly would demand further experiments with this plant, especially in consideration of the ease with which it is grown and the abundant yield to the acre.

An experiment was also made with a new grass from Guatemala, the Teosinte (*Euchlæna luxurians*), a coarse grass somewhat resembling maize in its habit. In the experiment 316 pounds of stripped stalks, which had suffered from a heavy frost, yielded 170 pounds of juice, of specific gravity 1.022, or 53.8 per cent. of juice in stripped stalks. Of this juice, 134 pounds yielded 7¾ pounds of very good sirup in appearance, but it had a bitter taste and contained no crystallizable sugar. The juice was very impure, but was very readily and completely clarified with lime; and although this experiment failed to show any crystallizable sugar, it was probably due to the frost to which the stalks had been subjected, and this plant will therefore receive further attention another season.

In the experiments with sorghum and maize it was mentioned that, owing to the want of a suitable vessel for concentrating the sirup, the proper degree of concentration which would secure the maximum amount of crystallization was not attained; but while awaiting the concentrating pan it was found that crystallization had taken place in each one of the several lots of sirup, and it was therefore thought best to secure the first crop of sugar, and concentrate the sirup drained from these crystals.

This was effected, in the absence of a centrifugal machine, which would have facilitated the operation greatly, by squeezing out the sirup by means of a common press, the sirup and crystallized sugar being inclosed in a stout grain-bag.

This rude method not sufficing to remove the uncrystallized sirup wholly, and leaving the sugar-crystals adhesive from the small quantity of molasses remaining, a small quantity of water was added to the moist sugar, sufficient to dissolve some 5 per cent. of the sugar, and after stirring the mass about, and again subjecting it to pressure, the molasses was almost completely removed, and the sugar obtained in a most satisfactory condition in every respect, comparing most favorably with the best raw sugar of the market, as will be at once seen by reference to their very high polarization: Maize sugar, 90°; sorghum sugar, 94°; millet sugar, 92°.

Moreover, the quantity of sugar thus obtained, although much below the maximum, was in the case of experiment No. 10, with sorghum, equal to 34.6 per cent. of the weight of the sirup; in the case of the sorghum in experiment No. 6, to 31.3 per cent. of the sirup; while in the case of maize, in experiment No. 2, the amount of sugar thus obtained was 32 per cent. of the weight of the sirup. The sirup obtained by expressing it from these sugars still has a large quantity of crystallizable sugar, as is evident by the fact that they are again granulated rapidly, and they show a polarization of 36° for the maize sirup and of 43° for the sorghum sirup.

Arranging, then, the results of these three experiments, Nos. 2, 6, and 10, we have the following results:

Experiment No. 10, with sorghum sirup, yielded 34.6 per cent. of sugar, polarizing 94°; 65.4 per cent. of sirup, polarizing 43°.

Experiment No. 2, with maize sirup, yielded 32 per cent. of sugar, polarizing 90°; 68 per cent. of sirup, polarizing 36°.

Experiment No. 6, with sorghum sirup, yielded 31.3 per cent. of sugar, polarizing 94°; 68.7 per cent. of sirup, polarizing 43°.

In the other experiments varying results were obtained, owing to the reason already given, viz., the unequal degree of concentration of the sirups, and consequently a lesser product of sugar, but an increased product in sirup, which still contained a large amount of crystallizable sugar. Thus, in experiment No. 4, there was obtained 14.6 per cent. of sugar. In experiment No. 7 there was obtained 19.6 per cent. of sugar. In experiment No. 8, there was obtained 17.8 per cent. of sugar. In experiment No. 9 there was obtained 20.9 per cent. of sugar.

In the following table I give the degree of polarization, *i. e.*, the percentage of pure cane sugar, in the several samples of raw sugar obtained:

	Per cent.		Per cent.
In experiment No. 1	89.	No. 7	79.6
No. 2	87.	No. 8	88.8
No. 3	91.5	No. 9	81.5
No. 4	87.	No. 10	82.8
No. 5	88.5	No. 11	84.6
No. 6	82.5		

The sugars obtained in some of the above experiments were washed slightly, and their appearance was greatly improved thereby, and the following results as to polarization were obtained:

	Per cent.		Per cent.
No. 2 polarized	91.2	No. 7 polarized	89.6
No. 4 polarized	89.6	No. 9 polarized	04.
No. 6 polarized	87.9	No. 11 polarized	87.9

A small experiment, preliminary to those above recorded, was made with stalks of maize, and as it was within the means at the command of the laboratory, it was carried to a full conclusion, except only in this, that the stalks were cut in an ordinary hay-cutter, then beaten in a mortar, and the juice expressed by a small hand-press.

The amount of juice thus obtained was less in amount and poorer in quality than could have been obtained by the use of a good machine, but owing to the completeness of the results this small experiment has considerable value as indicating what may be done on a more generous scale and with the necessary appliances. In this experiment 28.18 pounds of raw stalks were taken, which gave of stripped stalks 19.08 pounds. From these stalks there were obtained 8.43 pounds of juice of a specific gravity 1.065.

This juice, after clarification and evaporation, gave an excellent sirup which was concentrated to a boiling point of 112° Centigrade, equal to 234° Fahrenheit, and this sirup speedily crystallized, and yielded of excellent sugar .55 pound, and of molasses .28 pound.

According to the above result, one ton of raw stalks would have yielded of sugar 39.03 pounds, and of molasses 19.87 pounds.

As has been already said, there is no doubt but that a more thorough removal of the juice from the stalks would nearly, if not quite, have doubled the above yield, but the experiment is valuable as showing the facility with which a very large percentage of crystallizable sugar may be obtained from the sirup, amounting in this case to what would be regarded as an excellent result, even when working with sugar-cane, viz., almost exactly two-thirds the entire weight of sirup obtained as crystallized sugar in the first crop of crystals obtained from the sirup.

The above experiments, although confessedly far from being complete, have at least established the fact that there is no trouble in making sugar from corn and sorghum, and they have this merit also, that everything has been done quantitatively, so that each may see for himself where there is room for improvement, and can calculate with some degree of accuracy the probable yield per acre of these crops in sugar, and the cost of manufacture.

An experiment was also made with a small lot of sugar-beets, received from F. D. Curtis, of Charlton, Saratoga County, New York, the object being to learn whether the process for the preparation of sugar from corn and sorghum, as above described, was applicable to beets; 14.5 pounds of sugar-beets were ground up, and 7.87 pounds of juice were expressed, having a specific gravity of 1.030. This juice yielded a sirup which crystallized readily within twelve hours, and yielded .61 pound of sugar, which polarized 91.7° and .58 pounds of sirup, from which an additional quantity of sugar may doubtless be obtained.

Still another experiment was made with a larger sample of sugar-beets and the result was the easy production of sugar of a very dark color, but which was easily refined, and in this dark condition polarized 91.5 per cent.

The molasses expressed from the above maize and sorghum sugars, owing to want of space in the laboratory for storing the several tubs containing it, was added together as follows:

Tub A, from maize, Nos. 2, 3, 4.

Tub B, from sorghum, Nos. 6, 7, 8, 9, 10, 11.

Tub C, from sorghum, Nos. 12, 13, 14, 15.

No. 1, from maize, and No. 5, from sorghum, were kept apart, these sirups having been somewhat scorched in their manufacture.

A second crop of sugar continued to form in these lots A, B, and C,

and after carefully removing these crystals of sugar, an examination was made of the molasses, in order to determine its purity and the nature of those substances present besides cane sugar, water, and inverted sugar.

The following analyses represent the composition of these samples of molasses, both as to its proximate constituents and also the constituents of the ash:

Proximate analyses of molasses from sorghum and maize sugars.

Constituents.	Corn, A.	Sorghum, B.	Sorghum, C.
	Per cent.	*Per cent.*	*Per cent.*
Sucrose	32. 64	33. 25	22. 68
Inverted sugar	32. 93	31. 81	52. 79
Gum	9. 08	9. 77	5. 51
Water	21. 88	21. 24	16. 32
Ash	4. 06	4. 90	3. 33
	100. 59	100. 97	100. 69

Analyses of the ashes of molasses from sorghum and maize sugars.

Constituents.	Corn, A.	Sorghum, B.	Sorghum, C.
	Per cent.	*Per cent.*	*Per cent.*
TOTAL ASH	4. 06	4. 90	3. 33
Silicic acid	. 38	2. 86	4. 60
Chlorine	2. 18	3. 96	7. 51
Sulphuric acid	5. 70	3. 90	3. 06
Phosphoric acid	. 97	1. 04	Trace
Lime	38. 98	24. 39	19. 01
Magnesia	8. 02	7. 00	7. 35
Potassa	41. 38	52. 50	55. 55
Potassium	2. 39	4. 36	2. 92
	100. 00	100. 00	100. 00

A small portion of the molasses, A, B, and C, was submitted to alcoholic fermentation, the alcohol obtained by distillation, and the resulting product, which in each case closely corresponded to the sugar present in the different molasses, was filtered through bone-black.

By the above process was obtained in each case high wines quite free from fusel oils, containing 38 to 40 per cent. of alcohol and possessing peculiar but not disagreeable properties.

It is obvious that in the manufacture of sugar from corn-stalks and sorghum the skimmings from the evaporator may be thus readily utilized in the preparation of high wines or vinegar.

SORGHUM SUGAR-GUM OR ZUCKERSCHLEIM.

The large class of gummy bodies has been almost universally divided into two groups, the gums proper and the vegetable mucilages. In German chemical literature these groups are called, respectively, Gummi and Schleime. Sachsse, in his *Chemie und Physiologie der Farbstoffe Kohlehydrate und Proteinsubstanzen*, distinguishes them by the following characteristics:

The Schleime, histologically, are more nearly related to cellulose than the gums are, being derivatives of the cell membranes for the most part.

The Schleime are distinguished by their relation to iodine, by which they are colored blue or violet.

The Schleime give on oxidation with HNO_3 oxalic acid, but no mucic acid.

The Gummi are never colored blue by iodine or iodine and acids.

The Gummi give, on oxidation, with HNO_3 mucic acid.

The two groups, therefore, although so similar in exterior appearance, are easily distinguished by these striking characteristics.

One other peculiarity may be added that, as far as has been investigated, the Schleime possess no optical activity, while the gums, as a rule, are quite the reverse.

The gum which has been extracted from the sorghum molasses is plainly to be classed, from its reactions and characteristics, among the vegetable mucilages, although it agrees with no hitherto-known member of that class. It gives oxalic acid and no mucic acid on oxidation, is colored blue by alcoholic iodine and hydrochloric acid, and is optically inactive.

Its extraction and preparation in a pure state was carried out as follows: 500 grams of the molasses were dissolved in a half litre of water, and to this sufficient 95 per cent. alcohol added to make the resulting liquid 80 per cent. alcohol. This caused a precipitation of the gum, while the sugar and much coloring matter remained in solution. The precipitated gum was washed with 80 per cent. alcohol by decantation until the supernatant liquid showed no coloration. The gum, after the evaporation of as much as possible of the adhering alcohol, was dissolved in a little water, and the solution, which was of inky blackness, warmed for a short time with purified bone-black, was filtered through a hot ribbed filter. The resulting filtrate was of a straw-yellow color, and on precipitation by alcohol gave a flocculent snow-white gum, which was washed alternately by 80 per cent. alcohol, 95 per cent., and absolute alcohol, and then on a cloth filter with absolute alcohol and ether. The first attempt to dry the gum, on removing it from the filter, was a failure. Over sulphuric acid it shrunk up to a gummy, black, oxidized mass which was striking in comparison to the snowy whiteness of the original substance. It was found necessary to wash very thoroughly with absolute alcohol and ether on the Bunsen pump, and then to dry rapidly in a stream of CO_2 at common temperatures, breaking up the lumps which formed from time to time.

The gum so prepared is a white powder, easily oxidizing on exposure to the air and turning black. It is somewhat deliquescent. Under 80 per cent. alcohol it may be preserved indefinitely as a snow-white substance. In aqueous solution it separates on standing, a thick scum or skin forming on the surface. This scum is not colored in any way by iodine, and appears to be some decomposition product of the original substance into a true gum, like tragacanth. Such a decomposition has been suspected in other vegetable mucilages.

Owing to the difficulty of obtaining the gum dry in a condition fit for analysis, no combustion has been made. It contains a small amount of ash. Below are some of its reactions in aqueous solution:

C_2H_6O	Precipitates flocculent.
$NaOH$	Precipitates flocculent.
HCl	Clears up a turbid solution.
$Pb(C_2H_3O_2)_2$	Heavy precip.
$Pb_3O_2(C_2H_3O_2)_2$	Light precip.
HNO_3	Oxidized to $(COOH)_2$
Fe_2Cl_6	No precip.
$HgCl_2$	No precip.
Tannic acid	No precip.

Permanganate	Rapid oxidation.
$Ag\,N\,O_3$	Heavy precip., reddens by light.
$N\,H_4\,O\,H$	Flocky precip.
Ammon. acet. zinc.	Heavy precip.
$Ba\,O_2\,H_2$	Heavy precip.
$Cu\,(C_2\,H_3\,O_2)_2$	Precip. sol. in excess.
Cochineal solut.	Purple flocky precip.
Fehling solution,	Gives a flocky precip., soluble in an excess, but reducing only slightly, even on long boiling, and that probably owing to a trace of sugar in the gum.

As has been said before, the gum is colored bright blue by iodine and acids, but only under certain conditions. It must be in a dry state before adding H Cl, and the iodine must be in alcoholic solution. A solution of K I and I in water gives a violet coloration. In this respect the gum agrees perfectly with quince mucilage, which gives the same reactions with iodine peculiar, it seems, to these two substances.

That it does not rotate the ray, of light shows that it is quite different from any of the true gums, which are all optically active, dextrin, which it resembles in many other respects, having a specific rotation of $+2.35°$.

In a pure condition it has no odor, but the alcohol which is decanted from it in the process of washing has a powerful odor similar to gingerbread, and from this smell the alcohol cannot be purified by distillation. It seems to be identical with the disagreeable odor of the alcohol distilled from the sirup, and to it is due, perhaps, the disagreeable taste sometimes perceived in sorghum sirups.

Analogous experiments with cane molasses show that the same or a similar gum is present in cane, but in a very much smaller amount. Whether the gum is already formed in the plant at the time of expression of the juice is a question still open, but from analogy we might reason that there is at least a time at which we should express the juice from the canes to obtain a minimum of gum. No method for the removal of the gum after its actual formation seems possible. A quantitative estimation by Mr. Wellington shows that there is about 9 per cent. of the substance in the sirup on which we have worked.

The following reports received by the department during the past year will show the practical results thus far secured in the production of sirup from sorghum. These results are arranged according to yield per acre.

1. Edgar Beebe, La Fayette County, Wisconsin, 320 gallons good, clear sirup.
2. J. W. Henry, Pikeville, Bledsoe County, Tennessee, 275 gallons heavy sirup.
3. Peter Spear, Bledsoe County, Tennessee, 275 gallons.
4. C. A. Harrison, Van Buren, Michigan, 260 gallons, very fine, on sand loam; 235 gallons, good, on heavy clay; 232 gallons, good, on light loam.
5. J. B. Brown, Redwood County, Minnesota, 220 gallons dense sirup.
6. H. F. L. Lagenhadt, Miami County, Ohio, 173 gallons.
7. Wm. B. Simpson, Laclede County, Missouri, 170 gallons.
8. H. J. Mallory, Levanna, Cayuga County, New York, 167 gallons extra sirup.
9. John Higinbotham, Richland County, Wisconsin, 160 gallons good.

10. C. O. Pearson, McHenry County, Illinois, 160 gallons, fine quality.
11. E. W. Stewart, Erie County, New York, 156 gallons.
12. J. J. W. Smith, Marshall County, Mississippi, 145 gallons.
13. H. Silver, Pope County, Minnesota, 144 gallons.
14. J. S. Thompson, Cumberland County, New Jersey, 144 gallons.

The average of the above returns is a little more than 200 gallons of sirup from an acre. The sorghum giving these results was in every case the Minnesota Early Amber. Ten different States are included in the above returns. There is, therefore, no reason to doubt that with ordinary care the production of sirup may be equal to at least 200 gallons to the acre, and by proper means in its preparation at least 8 pounds of sugar to the gallon may be secured, or 1,600 pounds of sugar to the acre, besides the molasses, which would amount to 800 or 1,000 pounds more.

ANALYSES OF CANE, MAIZE, AND SORGHUM SUGARS.

I give below for comparison the results of analyses of several sugars received at the department from different sources. These are all open-pan sugars, similar to and comparable with the sugars made at the department from maize and sorghum.

No. 1. Tahiti, from sugar cane.
No. 2. Porto Rico, from sugar cane.
No. 3. New Orleans, from sugar cane.
No. 4. Maize, from F. L. Stewart, Murrysville, Pa.
No. 5. Maize, from F. L. Stewart, Murrysville, Pa.
No. 6. Sorghum, from L. C. Mattox, Homerville, Ga.
No. 7. Sorghum, from William Hughes, Dupont, Ga.
No. 8. Sorghum, from F. L. Stewart, Murrysville, Pa.

Number of analysis.	Sucrose.	Inverted sugar.
	Per cent.	*Per cent.*
No. 1	87	6.86
No. 2	89	7.47
No. 3	84	9.78
No. 4	89	7.28
No. 5	82	7.95
No. 6	94	2.58
No. 7	91	5.08
No. 8	83	11.03

It will be observed that the sugars from corn and sorghum compare favorably with those from sugar cane in the above list.

ASH ANALYSES OF SUGAR CANES FROM DEMERARA AND OF SORGHUM (EARLY AMBER).

No. 1. Plant cane, from Demerara.
No. 2. Rattoon cane, from Demerara.
No. 3. Rattoon cane, from Demerara.
No. 4. Early Amber sorghum, from Riggs's farm, near Washington.
No. 5. Early Amber sorghum, from Montgomery County, Maryland.
No. 6. Sorghum, from Tennessee.

Constituents.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Silica	20.28	34.90	35.54	8.97	2.93	18.36
Chlorine	17.03	1.55	1.59	3.91	13.24	39
Sulphuric acid	5.05	19.73	18.50	5.55	11.70	4.85
Phosphoric acid	7.11	1.96	2.04	3.64	4.50	11.98
Lime	1.32	1.76	1.80	13.49	9.00	24.95
Magnesia	5.96	6.07	5.86	10.47	10.28	13.70
Potassa	24.47	32.31	32.91	49.66	33.77	25.70
Potassium	18.78	1.72	1.76	4.31	14.58	.43
	100.	100.	100.	100.	100.	100.
Total ash in dry cane	1.58	2.42	2.46	1.79	1.59	1.63
CO_2 in crude ash	5.49	1.08	....	17.09	11.88	14.07

SUGAR-BEETS.

During the year 1878 there were sent out from the Department the following varieties of sugar-beet seed, viz:

Lane's improved, from Rockford, Ill.
White red-top, from Vilmorin & Co.
White small-rooted, from Vilmorin & Co.
Silesian green-top, from Vilmorin & Co.
Vilmorin's improved, from Vilmorin & Co.

A circular-letter was sent after the several parcels of seed, requesting replies to the following questions:

1st. Time of planting.
2d. Depth of plowing.
3d. Quantity of seed used per acre or fraction thereof.
4th. Distance of rows from each other.
5th. Distance between beets in the row.
6th. Time of harvesting.
7th. The nature of the soil and subsoil.
8th. What kind of manure was applied?
9th. Had the ground been previously well manured?
10th. Are you in the habit of raising root crops every year?
11th. Did the drought at the end of June and beginning of July perceptibly interfere with the sugar-beets?
12th. What is the cost of raising sugar-beets? State cost in money value, if known, or your opinion of cost, as compared with other root crops.
13th. Have the beets suffered from frost; and, if so, at what date?
14th. What other crops, if any, suffered from the same frost?
15th. Have insects infested the sugar-beet crop; and, if so, what kind?
16th. What other peculiarities did you observe regarding this special crop?
17th. What quantity in weight of beets did you harvest per acre?

An invitation was also extended to those raising the beets to send specimens to the department for analysis.

In reply to this invitation there have been received fifty seven specimens of beets, the analyses of which are given hereafter.

Of the fifty-seven sending beets forty-nine sent replies to the above questions concerning their culture.

Replies to the above list of questions were received from fourteen, from whom no samples of beets have been received for analysis.

Eight of those sending beets for analysis have as yet failed to reply to the questions.

The results of the analyses were in every instance forwarded to those sending the beets, and these results are tabulated below:

Analyses of

[These analyses are arranged according

Number of specimen.	Name of experimenter.	Township.	County.	State or Territory.	Character of soil.	Character of subsoil.
1	R. H. Harris	Monument	El Paso	Colo.	Rich dark loam	
2	Aug. Stevens	Blue Hill	Hancock	Me	Sandy loam	
3	S. F. Rittall	Dresden	Lincoln	do	Clay loam	Clay
4	F. D. Curtis	Charlton	Saratoga	N. Y.	do	do
5	J. L. Packer	Corning	Steuben	do	Sandy loam	do
6	H. B. Sheldon	Covelo	Mendocino	Cal	do	
7	Mrs. A. G. Smoot	Mitchell's Station	Culpeper	Va	Dark red loam	Heavy red.
8	F. J. White	South Deerfield	Rockingham	N. H.	Light loam	Hardpan
9	Henry Wild	Sarcoxie	Jasper	Mo	Black loam	
10						
11	F. W. Smith	Rockland	Knox	Me	Sandy loam	Hardpan
12	W. D. Curtis	Carlton	Orleans	N. Y.		
13	J. B. Meehan	El Paso	Pierce	Wis	Clay loam	Clay
14	D. W. Nason	Epping	Rockingham	N. H.	Sandy clay loam	Hardpan
15	W. H. Hopkins	Providence	Providence	R. I.	Sandy loam	Yellow
16						
17	G. W. Bell	Vineland	Cumberland	N. J	Gravel loam	Gravel
18	Nathan Jewett	New London	New London	Conn	do	do
19	W. A. Mohler	Hamburg	Shenandoah	Va	Light gravel	Clay
20	F. W. Greening	Cadmus	Lincoln	Kans	Black loam	do
21	J. L. Packer	Corning	Steuben	N. Y.	Sandy loam	do
22	Mrs. A. G. Smoot	Mitchell's Station	Culpeper	Va	Dark red loam	Heavy red.
23	Edw. Daniel		Fairfax	do	Sandy	Clay
24	J. L. Packer	Corning	Steuben	N. Y.	Sandy loam	do
25	G. R. Hersey	Bath	Sagadahoc	Me	do	
26	Nathan Jewett	New London	New London	Conn	Gravel loam	Gravel
27	C. B. Hartman	Weaver's Station	Duke	Ohio.	Sandy loam	Sandy clay
28	F. Raymond	Sioux Falls		Dak	do	
29	R. I. Soc. D. Indust.	Providence	Providence	R. I.	do	Yellow
30	Nathan Jewett	New London	New London	Conn	Gravel loam	Gravel
31	A. W. Shaffer	Raleigh	Wake	N. C	Clay	
32	Farm and Garden Club	Bloomington	Oneida	Idaho	Gravel loam	Clay
33	Peter Henderson	New York	New York	N. Y.		
34	do	do	do	do		
35	do	do	do	do		
36	D. Landreth & Son	Philadelphia	Philadelphia	Pa		
37	do	do	do	do		
38	do	do	do	do		
39	do	do	do	do		
40	do	do	do	do		
41	do	do	do	do		
42	do	do	do	do		
43	do	do	do	do		
44	do	do	do	do		
45	do	do	do	do		
46	do	do	do	do		
47	do	do	do	do		
48	do	do	do	do		
49	do	do	do	do		
50	do	do	do	do		
51	do	do	do	do		
52	do	do	do	do		
53	do	do	do	do		
54	do	do	do	do		
55	do	do	do	do		

sugar beets.

to percentage of sugar in juice.]

Kind of manure applied this year.	Had the land been fertilized before this year?	Kind of seed sown.	Yield of crop per acre in tons.	Estimated cost of crop per acre.	Mean weight of root in pounds.	Per cent. of juice expressed from root.	Per cent. of sugar in juice.	Per cent. of foreign matter in juice.	Per cent. of sugar in soluble matter in juice.	Per cent. of sugar obtained from root.	Specific gravity of juice.	Per cent. by weight of root below leaf-marks.	Number of specimen.
None	No	Vilmorin's Improved	....	....	.94	42.26	20.01	2.57	88.62	8.46	1.103	90.36	1
Barn-yard		....do	....	....	.55	51.19	17.28	4.77	78.37	8.84	1.100	90.22	2
....do	No		12.	$68	1.10	73.64	15.82	1.97	88.93	11.64	1.079	91.37	3
Old barn-yard	Yes	Silesian Green-Top	16.	22	1.38	52.72	15.42	2.77	84.77	8.13	1.080	85.87	4
None	do	Vilmorin's Improved	11.	45	2.21	54.30	12.27	2.46	83.30	6.66	1.071	92.49	5
Barn-yard	No	White Green-Top	10.	....	1.41	57.78	11.52	4.57	71.60	6.66	1.072	86.00	6
....do	do	White Small-Rooted	6.	15	1.01	45.87	11.47	2.94	79.60	5.25	1.063	84.80	7
....do	Slightly	....do	19.	....	2.39	73.69	11.32	3.21	77.91	8.33	1.063	82.80	8
None	do	Vilmorin's Improved	18.5	....	1.11	56.56	10.93	6.40	63.07	6.17	1.079	73.40	9
			....	....	2.23	75.98	10.80	2.98	78.38	8.21	1.060	67.77	10
Barn-yard		White Red-Top	19.5	....	.97	71.80	10.20	2.12	82.79	7.32	1.055	86.65	11
			....	....	1.25	57.83	9.09	3.10	74.57	5.26	1.056	85.51	12
None	No	White Small-Rooted	13.	60	2.00	66.33	9.02	3.50	72.05	5.98	1.057	77.03	13
Barn-yard	Yes	Lane's Improved	43.5	....	1.60	63.00	8.18	3.32	71.13	5.15	1.050	79.10	14
....do	No		27.	81	1.50	53.53	8.07	2.87	73.77	4.32	1.051	78.58	15
			....	....	5.12	78.14	7.64	3.64	67.73	5.97	1.049	82.24	16
Night-soil, &c.	Yes	White Green-Top	....	....	1.81	65.95	7.43	4.05	64.72	4.70	1.053	78.42	17
Barn-yard	do		30.	....	1.26	60.34	7.27	7.17	50.34	4.39	1.072	78.49	18
....do	do	Lane's Improved	....	....	1.69	56.57	7.10	3.12	68.79	4.02	1.050	63.57	19
None	No		5.	....	.69	54.54	6.90	3.76	64.73	3.76	1.051	73.57	20
....do	Yes		11.	45	3.00	49.21	6.64	3.24	67.21	3.27	1.050	83.05	21
Barn-yard	No	White Small-Rooted	....	....	3.40	70.11	5.40	4.11	56.78	3.76	1.043	59.60	22
....do	Yes		....	....	1.50	55.23	4.91	4.18	54.01	2.56	1.043	85.20	23
None	do	Lane's Improved	21.	84	2.53	72.87	4.57	3.51	56.56	3.34	1.040	79.12	24
Rotten seaweed			11.	....	5.79	67.69	4.56	4.11	52.59	3.09	1.042	93.64	25
Barn-yard	Yes		30.	....	10.34	66.71	4.37	4.16	51.23	2.91	1.044	62.94	26
None	No	Silesian Green-Top	29.	8	1.95	67.38	4.18	7.27	36.51	2.82	1.032	72.44	27
Barn-yard	Yes	Lane's Improved	18.	18	3.10	76.51	4.04	3.12	56.42	3.09	1.035	79.17	28
....do	No		27.	81	2.27	71.13	3.12	3.72	45.61	2.22	1.036	94.27	29
....do	Yes		30.	....	4.23	60.52	2.95	7.34	28.67	1.78	1.056	74.72	30
Ashes and night-soil.	No	Silesian Green-Top	....	....	1.78	75.93	2.67	3.45	43.62	2.02	1.030	45.83	31
None	Yes		7.	10	.60	41.67	.....	(*)	.....	.....	1.145	87.77	32
		Improved White Sugar	85.	....	8.28	78.51	2.18	3.71	37.01	1.71	1.023	.....	33
		Improved Kimer's Yellow Globe Mangel.	75.	....	7.24	77.62	2.01	3.29	37.93	1.56	1.026	.....	34
		Improved Norbitan Giant Mangel.	70.	....	6.39	73.79	1.08	4.98	17.82	.80	1.030	.....	35
		White Improved Vilmorin.	13.	42	1.41	60.51	8.42	3.74	69.24	5.09	1.055	70.25	36
		White German Green-Top.	....	....	1.84	58.53	7.78	3.08	71.64	4.55	1.050	70.13	37
		Vilmorin's Improved White.	....	....	1.76	63.43	7.71	2.67	74.28	4.89	1.047	71.48	38
		White Improved Electoral.	....	....	1.53	65.36	6.83	3.71	64.80	4.05	1.047	65.44	39
		White Improved Imperial.	....	....	1.80	71.90	5.86	3.93	59.86	4.21	1.046	71.72	40
		White Silesian Red-Top.	....	....	1.52	65.30	5.69	3.09	64.81	3.72	1.042	68.30	41
		White Breslau	....	....	4.15	64.78	5.31	3.00	63.89	3.44	1.038	74.67	42
		White Improved Imperial.	....	....	2.02	69.32	5.31	2.80	65.47	3.68	1.038	68.19	43
		White Improved Electoral.	....	....	2.40	65.92	5.01	3.52	58.73	3.30	1.040	61.29	44
		White Silesian Sugar	....	....	1.80	71.31	4.94	2.39	67.39	3.52	1.034	69.13	45
		White Silesian Gray-Top.	....	....	3.10	77.05	4.91	2.92	62.71	3.79	1.038	80.96	46
		White Silesian Green-Top.	....	....	2.65	69.08	4.84	2.93	62.29	3.34	1.037	67.42	47
		Womgelburg Sugar	....	....	2.42	72.29	4.62	3.03	60.39	3.34	1.038	68.66	48
		White Improved Imperial.	....	....	1.90	70.45	4.52	3.55	56.01	3.17	1.036	74.72	49
		White Magdeburg	....	....	1.93	73.01	4.52	3.07	59.55	3.30	1.038	70.27	50
		Quedlinburg	....	....	1.91	70.78	4.35	2.80	60.84	3.08	1.033	66.34	51
		White Silesian Sugar Red-Top.	....	....	2.33	72.33	4.33	3.10	58.28	3.13	1.035	74.89	52
		White Magdeburg	....	....	1.88	62.62	3.95	2.48	61.43	2.47	1.033	69.47	53
		Lane's Improved	....	....	2.54	76.85	3.87	2.51	60.66	2.97	1.030	71.40	54
		White German Green-Top.	....	....	3.31	77.25	3.56	3.39	51.22	2.75	1.034	71.94	55

* This juice had no effect upon polarized light; total solids in juice = 30.35 per cent.

Analysis of sugar

Number of specimen.	Name of experimenter.	Township.	County.	State or Territory.	Character of soil.	Character of subsoil.
56	D. Landreth & Son	Philadelphia	Philadelphia	Pa.		
57	....do	....do	....do	.do		
58	W. M. Bryant	Industry	Franklin	Me	Gravel loam	
59	C. F. Calef	Saco	York	.do	Sandy loam	Clay
60	J. A. Camp		Erie	Ohio.	Black loam	Sandy clay
61	J. Finson	Hartland	Somerset	Me	Deep loam	Gravel
62	Far., Gar., and For. Club	Gunnison	San Pete	Utah	Sandy loam	
63	C. Hapgood	Hot Springs	Red Bluff	M. T.	Clay and sandy loam.	
64	Isbell, Page & Loyd	Ripon	Jefferson	W.Va	....do	Limestone.
65	R. Parent	Shelbyville	Shelby	Ky	Limestone loam	Clay
66	R. Prince	Bangor	Penobscot	Me	Clay loam	..do
67	G. A. Russell		Kennebec	.do.	Clay and gravel	
68	G. Wingate, jr	Avon	Livingston	N. Y.	Gravel loam	
69	J S. Morton	Nebraska City	Otoe	Nebr		
70	E. H. Pray	Bristol	Lincoln	Me	Gravel	
71	J. D. Mallett	Topsham	Sagadahoc	.do	Clay and gravel	Clay

beets—Continued.

Kind of manure applied this year.	Had the land been fertilized before this year?	Kind of seed sown.	Yield of crop per acre in tons.	Estimated cost of crop per acre.	Mean weight of root in pounds.	Per cent. of juice expressed from root.	Per cent. of sugar in juice.	Per cent. of foreign matter in juice.	Per cent. of sugar in soluble matter in juice.	Per cent. of sugar obtained from root.	Specific gravity of juice.	Per cent. by weight of root below leaf-marks.	Number of specimen.
...	...	White Breslau	...	...	1.86	69.20	3.08	2.69	53.38	2.13	1.029	73.47	56
...	...	Carter's Prize Nursery Sugar.	...	...	2.73	74.90	2.70	2.84	48.74	2.02	1.027	74.53	57
Barn-yard	Yes	...	7.5	...	...	...	...	...	...	...	...	...	58
Compost	do	...	4.5	...	...	...	...	...	...	...	...	...	59
None	No	...	...	...	...	...	...	...	...	...	...	...	60
Barn-yard	Yes	...	10.	$33	...	...	...	...	...	...	...	...	61
do	No	...	4.5	8	...	...	...	...	...	...	...	...	62
do	Yes	...	...	...	...	...	...	...	...	...	...	...	63
do	do	...	...	...	...	...	...	...	...	...	...	...	64
Old barn-yard	do	...	12.	5	...	...	...	...	...	...	...	...	65
do	do	...	20.	60	...	...	...	...	...	...	...	...	66
do	do	...	9.5	76	...	...	...	...	...	...	...	...	67
None	Slightly	...	18.5	...	...	...	...	...	...	...	...	...	68
...	...	...	...	...	...	...	...	...	...	...	...	...	69
Barn-yard, &c	Yes	...	24.	...	...	...	...	...	...	...	...	...	70
do	do	...	17.5	70	...	...	...	...	...	...	...	...	71

Quality of sugar beets.

Number of specimen.	Mean weight of root in pounds.	Per cent. of juice in root.	Per cent. of sugar in soluble matter of juice.	Per cent. of sugar in juice.	Per cent. of sugar in root.	Per cent. of root below leaf-marks.	Specific gravity of juice.	Kind of manure applied this year.
BEST 5.								
3	1.10	73.64	88.93	15.82	11.64	91.37	1.079	Barn-yard.
1	.94	42.26	88.62	20.01	8.46	90.36	1.103	None.
4	1.38	52.72	84.77	15.42	8.13	85.87	1.080	Stable.
5	2.21	54.30	83.30	12.27	6.66	92.49	1.071	None.
11	.97	71.80	82.79	10.20	7.32	86.65	1.055	Stable.
Mean	1.32				8.44	89.35		
POOREST 5.								
18	1.26	60.34	50.34	7.27	4.39	78.49	1.072	No report.
29	2.27	71.13	45.61	3.12	2.22	94.27	1.036	Do.
31	1.78	75.93	43.62	2.67	2.02	45.83	1.030	Night soil and ashes.
27	1.95	67.38	36.51	4.18	2.82	72.44	1.032	None.
30	4.23	60.54	28.67	2.95	1.78	74.72	1.056	No report.
Mean	2.30				2.65	73.15		

The roots in the above list which come up to the requirement for a good sugar-beet, as regards the amount of foreign matter which accompanies the sugar in the juice, viz., not more than 20 per cent. of the total matter in solution, are the following, placed in the order of their comparative value:

No. 3, which contains 88.93 per cent. of sugar in soluble matter of the juice.
No. 1, which contains 88.62 per cent. of sugar in soluble matter of the juice.
No. 4, which contains 84.77 per cent. of sugar in soluble matter of the juice.
No. 5, which contains 83.30 per cent. of sugar in soluble matter of the juice.
No. 11, which contains 82.79 per cent. of sugar in soluble matter of the juice.

Next to these in value are *four* specimens, which contain more than 20 per cent. and less than 25 per cent. of impurity in the soluble matter of the juice, viz:

No. 7, which contains 79.60 per cent. of sugar in the soluble matter of the juice.
No. 10, which contains 78.38 per cent. of sugar in the soluble matter of the juice.
No. 2, which contains 78.37 per cent. of sugar in the soluble matter of the juice.
No. 8, which contains 77.91 per cent. of sugar in the soluble matter of the juice.

The poorest five specimens are Nos. 18, 29, 31, 27, 30, and compare with the best five as follows:

No. 18, which contains 50.34 per cent. of sugar in the soluble matter of the juice.
No. 29, which contains 45.61 per cent. of sugar in the soluble matter of the juice.
No. 31, which contains 43.62 per cent. of sugar in the soluble matter of the juice.
No. 27, which contains 36.51 per cent. of sugar in the soluble matter of the juice.
No. 30, which contains 28.67 per cent. of sugar in the soluble matter of the juice.

It is greatly to be regretted that we have been unable to secure full returns from those who sent beets for analysis, since the cumulative testimony thus secured from sections so remote would, from the large number of beets analyzed, have given us substantial data for conclusion as to several points of very great practical importance.

The following conclusions, however, appear obvious from the above results:

1. The best five samples received were in three cases manured with stable manure, while the other two received no manure or fertilizer whatever.

2. The best five, as will be seen, grew almost entirely below the surface, the average of the five giving 89.35 per cent. below ground, as compared with the poorest five, the average of which gave 73.15 per cent. below ground.

3. The smaller roots gave better results than the larger, since the first five samples averaged 1.32 pounds, while the poorest five averaged 2.30 pounds each.

PERUVIAN SWEET POTATOES.

The following results were obtained in a partial examination of specimens of sweet-potatoes sent from the valley of the river Chira, Department of Piura, Peru, by S. C. Montjoy, United States consul, Lambayeque, Peru.

From the letter received from Mr. Montjoy it appears that there are three well-known varieties of "Carmotes" or sweet-potatoes.

1. Porto Viejo, said to be very large, very sweet, and very abundant.
2. Boca Sagarto, not so large, but very much sweeter, and of better flavor.
3. Niña, smaller, excellent flavor, and very sweet.

Upon examination of the specimens received, it was easy to distinguish three varieties, as follows:

A. Skin, dark red; flesh, deep pink.
B. Skin, light pink; flesh, yellowish white.
C. Skin and flesh, yellowish white.

The average weight of the tubers was about $1\frac{1}{4}$ or $1\frac{1}{2}$ pounds.

An examination of the juice from the different samples gave the following results:

Estimation.	A.	B.	C.
Specific gravity juice	1.075	1.068	1.070
Per cent. juice expressed	34.61	37.12	27.67
Per cent. sugar in juice	11.01	9.44	11.01
Per cent. impurities in juice	6.41	5.61	4.31
Per cent. sugar in soluble matter	63.20	62.72	71.80

ANALYSIS OF YAM.

An analysis of the yam was made with the following results:

		Per cent.
Juice expressed, 46 per cent	Water	31.13
	Sugar	5.58
	Other solids	9.29
Pulp, 54 per cent	Water	20.92
	Sugar	3.75
	Other solids	29.33
		100.00

The expressed juice upon standing from one to two hours deposited a large amount of starch, nearly 8 per cent. of the juice by volume.

BEET-ROOT SIRUP.

A specimen of beet-root sirup received from Mr. B. W. Payne, Corning, N. Y., gave upon analysis the following results:

	Per cent.
Water	25.36
Sucrose	49.00
Inverted sugar	9.01
Other matters	16.63
	100.0[illegible]

SORGHUM SIRUP.

Several samples of sirups from sorghum have been sent to the department for examination for the purpose of learning why they failed to crystallize. In every case it has been found that through some defect in the preparation of these sirups the sucrose or cane sugar had suffered inversion to a very great extent, and thus prevented crystallization.

One sample analyzed, from Mr. Constantine Merrelas, Brookhaven, Miss., polarized only 28.65°, while another, from Jacob Latshaw, Cedarville, Ill., polarized only 29°.

This has been mainly the experience of the past quarter of a century with sirups from sorghum and from maize, and therefore the importance of the results obtained in the department and already furnished cannot be too highly emphasized, viz., that in not a single experiment was there a failure in securing good crystallization.

MANNA OR FIR SUGAR.

A specimen of so-called fir sugar was received from Joseph Schanno, Yakima, Washington Territory, through the Smithsonian Institution.

Upon examination it proves to be a very excellent specimen of manna.

It occurs as an exudation upon the branches of the fir trees, and is said to be so abundant as to break down the branches with its weight, which statement is perfectly credible after seeing the specimens sent for examination attached to the branches from which it had exuded.

As to its composition, properties, and use, reference is made to the United States Dispensatory.

ANALYSES OF TWO SIRUPS RECEIVED FROM JACOB LATSHAW, CEDARVILLE, ILL.

One of these samples was an ordinary dark-colored sirup, while the other was of a light color. The composition is given below:

Constituents.	Dark sirup.	Light sirup.
	Per cent.	*Per cent.*
Water	17.90	21.34
Ash, soluble in water	2.18	.59
Ash, insoluble in water	.63	.21
Cane sugar (sucrose)	20.01	None.
Starch sugar (glucose)	None.	77.41
Inverted sugar	48.69	None.
Not determined	1.59	.45
	100.00	100.00

The above analysis shows the dark-colored sample to have been, as it purported to be, an ordinary sorghum sirup. The light-colored sample was not derived from sugar cane nor from any saccharine-producing plant, but was probably made entirely from starch, being the substance known in commerce as starch sugar, or glucose.

The substitution of these handsome artificial sirups for true molasses or sirup is much more common than has been supposed. If properly made there is no known reason why their use should be deleterious, but

they have less sweetening power and cost less than the genuine sirup, although the latter may be, as in the present case, inferior in appearance.

Like artificial butter, the so-called oleomargarine, they may be perfectly harmless to the consumer, but common honesty demands that they be sold for what they truly are.

The amount and composition of the ash of molasses being of great value in enabling one to determine their true character, they are given below.

Analysis of ash of two sirups received from Jacob Latshaw, Cedarville, Ill.

Constituents.	Dark sirup.	Light sirup.
Per cent. of ash	2.81	.80
Per cent. of ash, soluble in water	2.18	.59
Per cent. of ash, insoluble in water	.63	.21

The amount of phosphoric acid was pretty large in the dark sirup, while in the light sirup there was none present. This difference, as also the great difference in the total ash, is very marked. The dark sirup under the microscope showed abundant crystals of cane sugar, and upon standing a small quantity of sugar was deposited, while the light sirup became in a short time semi-solid, and under the microscope presented no crystals of cane sugar, but an abundance of stellated crystals, characteristic of glucose.

There is, therefore, no reason to doubt but that this light sirup was simply a saturated solution of starch sugar, or glucose.

EXAMINATIONS FOR TANNIC ACID—ANALYSIS OF CAÑAIGRE ROOT.

The sample was taken from roots received by this department, in 1868, from Northwestern Texas. The roots are from 4 to 6 or 8 inches long by about 1 inch in diameter, deeply corrugated, of a dark-brown color externally, a deep red-brown color internally, and of a peculiar odor like madder. In fine powder it is of a light red-brown color.

The fresh roots received from the same locality were smooth in outline, and much resembled sweet-potatoes in form, but were dark-brown in color. In transverse section they were of a bright lemon-yellow color, which rapidly changed to red-brown by exposure to the air. They lost water very rapidly, becoming shrivelled like the roots previously received.

Both the fresh and the dry roots have a very astringent taste. In the fresh root, containing 68.07 per cent. of moisture, the tannin equalled 8.51 per cent., or 26.62 per cent. when calculated to water-free substance.

The air-dry roots, containing 11.17 per cent. of moisture, contain 23.45 per cent. of tannic acid, equivalent to 26.30 per cent. of tannin in strictly dry root. From the close agreement in the tannin estimations in the fresh and dry roots it would seem as if the tannin was not affected by long keeping.

This tannic acid is of the variety known as rheo-tannic acid, and is identical with that existing in rhubarb. In many respects cañaigre root resembled rhubarb, and the following analysis has been made with

a view to determine, if possible, the value of cañaigre root either as a tanning material or as a medicinal substance.

The following are the percentages extracted by solvents from the air-dry root, which contained 11.17 per cent. of moisture:

Cold water	41.48
Alcohol, 98 per cent	44.01
Alcohol, 85 per cent	48.19
Petroleum ether	.90
Chloroform	.92
Carbon disulphide	.96

Ether extracts varying amounts according to the time it is allowed to act. It will be observed that petroleum ether, chloroform, and carbon disulphide extract nearly the same amounts. The extract thus obtained was a yellow, soft-solid substance, freely soluble in alcohol, ether, benzole, carbon disulphide, and chloroform; insoluble in water. Its solutions have a faintly acid reaction. It is soluble, in greater part, in alkaline hydrates, with a beautiful pink to carmine color. Its faintly alkaline ammoniacal solution precipitates acetate of lead pink, and reduces potassium permanganate in the cold, and apparently reduces silver nitrate. This substance has been called *yellow resin* in this analysis, although it may contain traces of oil, chrysophanic acid, and emodin (Quar. Jour. Ch. Soc., x, 300). Alcohol extracts the above *yellow resin* and a red-brown substance in some particulars resembling the *erythroretin* of Schlossberger and Döpping (Ann. Ch. Pharm. *l*, 219).

This substance, when dried, is a brittle, red-brown solid, not fusible on the water-bath, soluble in alcohol and diluted alcohol, insoluble in water, and nearly insoluble in ether, chloroform, benzole, petroleum ether, carbon disulphide. With alkaline hydrates it dissolves to a beautiful purplish-red solution; excess of acid re-precipitates the substance. Alcohol also extracts the rheo-tannic acid already mentioned, together with some sugar and a red substance soluble in water.

Water extracts this red coloring matter, a brownish coloring matter insoluble in alcohol, ether, etc., together with gum, pectin, and sugar.

Dilute potassium hydrate, used after the substance had been thoroughly extracted by alcohol and water, was colored dark purplish red. When acidified the solution precipitated flocks of a deep red-brown substance, much resembling the red substance extracted by alcohol, but differing from it in being insoluble in alcohol.

In all these particulars this substance exactly corresponds with *aporetin*, and, accordingly, it has been so designated in this analysis.

The root contained considerable starch; the starch grains were medium-sized, round and ovate. The starch was converted into glucose by dilute sulphuric acid, and estimated from the glucose formed.

Albuminoids were calculated from the total nitrogen, by combustion with soda-lime.

Cellulose was determined in the residue after the extraction of all the above-named substances.

Moisture was determined from loss of weight at 110° to 120° C.; ash, by simple combustion.

The figures given are for ash-free substances, and direct estimations were made in every case, except for sugar and "red substance soluble in water." Oxalic and malic acids were not estimated.

Analysis of cañaigre.

Emodin?	Trace.	Soluble in alcohol.
Yellow resin	.93	
Red substance, soluble in alchol	10.48	
Red substance, soluble in water; Sugar	10.44	Soluble in water.
Rheo-tannic acid	23.45	
Gum, pectin, brown color	6.41	
Albuminoids	5.21	
Aporetin	4.78	
Starch	18.00	
Cellulose	4.52	
Ash	4.38	
Moisture	11.17	
	99.77	

Whether this root is valuable either for tanning purposes or for medicinal use must be determined by actual experimentation. The result of the analysis fails to show the presence of any substances that would prove injurious to leather, and the large proportion of tannic acid is certainly a favorable indication. In many particulars this root resembles rhubarb, and it seems probable that it may be used to advantage in place of rhubarb, where a more astringent medicine is indicated.

The rapid change of the fresh root from yellow to brown may be due to the change of yellow resin into the less soluble red-brown substances.

EXAMINATION OF DOCKS FOR TANNIN.

An examination of two species of our native docks, allied to the cañaigre, was also made, with the following results:

Rumex crispa:	
Tannin in fresh root	2.47 per cent.
Tannin in dry root	5.54 per cent.
Rumex obtusiloba:	
Tannin in fresh root	Traces.

A specimen of sumac (*Rhus glabra*) was received from Robert Horning, Onawa, Iowa, which was found to contain as follows:

Sumac (*Rhus glabra*):	
Tannin in fresh leaves	15.50 per cent.
Tannin in dry leaves	16.87 per cent.

An examination was also made of the pods of the *Balsamocarpon brevifolium* ("Algarrobo or Algarrobilla"), a plant growing in Peru, the seed pods of which are said to contain over 60 per cent. of tannic acid. Analysis showed a somewhat smaller amount than that mentioned, but about 20 per cent. of gum, and a little resin.

This substance seems well adapted for the manufacture of ink, for which purpose it is said to be extensively used, but it hardly appears possible that it should add very greatly to the commercial supply of tannin.

THE IMPORTANCE OF CAREFULLY SELECTED SEED.

There is no one perhaps disposed to doubt the superiority of good seed to poor or even ordinary seed. Indeed, repeated experiments

have fully demonstrated the superiority of fully developed and well-matured seed. A few years since the department secured from England a few bushels of oats (the Excelsior), which, by means of careful winnowing, had reached a weight of 51 pounds to the bushel. These oats were distributed over the country, and numerous reports received showed a crop which weighed 40 pounds and upwards to the bushel.

Without doubt, by continued selection of the heavier seeds, this remarkable weight could have been maintained, if not still more increased, but through neglect of this precaution, these oats, which promised such results, have already fallen down to the common level, and weigh from 28 to 32 pounds to the bushel.

It is well known that all seedsmen, in their efforts to develop any new variety, are most careful in this matter of selection; and since there is nothing to forbid the ordinary farmer from pursuing the same course and attaining equally satisfactory results, the conclusion is that its extreme importance has not been fully appreciated by our people.

To emphasize this point, a series of experiments has been made with different seeds, the results of which are given below. The seeds taken for this purpose were such as, from their size, could readily be picked over one by one, and comprised the following:

1. Maize, Stowell's Evergreen, sweet, grown in New England.
2. Maize, Improved Prolific, white, grown in Tennessee.
3. Maize, Compton's Early, yellow, grown in Pennsylvania.
4. Pease, Kentish Invicta.
5. Pease, Extra Early.
6. Pease, Sugar Pease.
7. Beans, Lima.
8. Beans, Golden Wax.
9. Beans, Dwarf German Wax.

These seeds were taken from the stores in the department, and there is no doubt that the percentage of vitality was almost, if not quite, 100.

One quart of each variety was taken, and by careful picking was divided into thirds, as follows: first the best third was selected, then the poorest half of the remainder, and the middle third remained.

Upon weighing a given bulk (one-quarter litre) of the best and poorest thirds, there were found but slight differences in weight, showing that really the seed was all good and full weight. The ratio of best to poorest thirds by weight was as follows:

	Best one-third.		Poorest one-third.
Maize, Stowell's Evergreen	100	to	96
Maize, Improved Prolific	100	to	101
Maize, Compton's Early	100	to	98
Pease, Kentish Invicta	100	to	97
Pease, Extra Early	100	to	99
Pease, Sugar Pease	100	to	100
Beans, Lima	100	to	103
Beans, Golden Wax	100	to	95
Beans, Dwarf German Wax	100	to	98

As will be seen from the above, in no case was the difference very marked, although in every case but two it was in favor of the best thirds. These exceptions doubtless arose from the large size of these seeds, which prevented their being closely packed in so small a vessel as that in which they were weighed out.

Next, 50 grams of each sample were weighed out, and the number of seeds present in this weight counted out, when the ratio of the weight of individual seeds was ascertained to be as follows:

	Best one-third.		Poorest one-third.
Maize, Stowell's Evergreen	100	to	67
Maize, Improved Prolific	100	to	67
Maize, Compton's Early	100	to	80
Pease, Kentish Invicta	100	to	70
Pease, Extra Early	100	to	77
Pease, Sugar Pease	100	to	71
Beans, Lima	100	to	69
Beans, Golden Wax	100	to	74
Beans, Dwarf German Wax	100	to	67
Average	100	to	71.33

We have here a difference of from 25 to 49 per cent., averaging 40 per cent., between the weight of the individual seeds in the best and poorest thirds.

An examination of several other samples of maize, pease, and beans only shows the difference above observed to be pretty constant, *e. g.*, the ratio of weight between an equal number of grains from the first and third thirds of nine samples of maize was 100 : 60; in six samples of pease, 100 : 69; in five samples of beans, 100 : 64; or an average of 100 : 63.7 = 57 per cent. difference.

When we consider that during the period of germination and the earlier stages of its growth, until in fact through well-developed foliage and rootlets the plant is able to appropriate and assimilate food from the atmosphere and earth, its entire supply of nutriment is derived solely from that stored up in the seed, the importance of the above difference in the amount of that supply of food is manifest.

It is not improbable that during the critical period in the life of the new plant there may result a feeble struggle for existence, upon the one hand, dwarfed in its full development, with its power of reproduction impaired, and every vital function in marked contrast with that plant which has in its early life received a more generous supply of food.

But another consideration remains, of equal importance with this quantitative difference in the food supply, viz., whether there exists also a qualitative difference; and for the purpose of determining this point complete proximate and ash analyses were made of several of the seeds mentioned, the results of which are given below:

Analyses of maize, pease, and beans.

Constituents.	Maize.						Pease.		Beans.	
	Stowell's Evergreen.		Improved Prolific.		Compton's Early.		Kentish Invicta.		Lima.	
	Best one-third.	Poorest one-third.	Best one-third.	Poorest one-third.	Best one-third.	Poorest one-third.	Best one-third.	Poorest one-third.	Best one-third.	Poorest one-third.
Water	6.11	5.85	8.09	7.07	6.48	6.70	7.63	7.23	9.01	9.61
Fats	8.59	7.41	4.99	5.18	5.02	5.59	1.43	1.11	1.60	1.50
Sugars	4.50	5.09	1.80	2.17	1.95	2.16	4.54	3.44	3.74	3.56
Starch	47.25	44.91	68.69	70.27	69.95	69.35	45.58	43.72	47.35	48.95
Gum or dextrin	17.23	20.07	2.90	2.50	2.75	2.80	8.72	9.82	9.50	9.30
Cellulose	2.25	3.07	2.72	2.59	2.01	2.17	4.54	5.94	3.97	3.81
Albuminoids	*7.39	*6.38	5.44	5.84	5.32	5.51	......	......	......	......
Soluble albuminoids	......	......	......	......	......	......	.41	1.07	.75	.67
Legumin	......	......	......	......	......	......	25.05	25.27	21.13	19.81
Zein	4.69	5.36	4.14	3.15	4.75	4.21	......	......	......	......
Ash, crude	1.99	1.86	1.23	1.23	1.77	1.51	2.10	2.40	2.95	2.79
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*A part of this albumen was soluble in water, resembling in properties the soluble albumen in pease and beans.

Under the head of nitrogenous or albuminoid matters in the above analyses there appeared to be at least four different kinds, viz:

1. In Stowell's Evergreen Sweet Corn part of the albumen is readily soluble in water, giving a clear solution, which is coagulated by acids.
2. In the two other varieties of corn the albumen is insoluble in water both before and after treatment with ether and alcohol.
2. The three samples of corn contain zein, an albuminoid, insoluble in water, but soluble in strong alcohol.
4. Beans and pease contain a small amount of an albuminoid, soluble in 95 per cent. alcohol and in water, and coagulated by acids.
5. Beans and pease also contain about 25 per cent. of legumin, which is soluble in water, insoluble in alcohol, and coagulable by dilute acids.

The composition of the ash in the above is as follows, excluding carbonic acid:

Composition of ash of maize, pease, and beans.

Constituents.	Maize.						Pease.		Beans.	
	Stowell's Evergreen.		Improved Prolific.		Compton's Early.		Kentish Invicta.		Lima.	
	Best third.	Poorest third.	Best third.	Poorest third.	Best third.	Poorest third.	Best third.	Poorest third.	Best third.	Poorest third.
Per cent. ash..	1.46	1.46	1.06	.94	1.36	1.27	2.10	2.40	2.95	2.79
SiO_2	.64	.55	.91	2.64	4.73	5.02	.79	.83	1.04	.23
P_2O_5	42.81	43.84	47.39	44.74	49.52	50.90	36.40	34.26	21.77	23.20
SO_3	....	....	....	....	....	....	3.32	3.42	1.67	.59
Cl	.48	.31	....	....	....	....	1.55	2.75	.86	.91
CaO	2.25	2.46	1.65	1.35	3.08	1.21	1.78	3.21	2.15	.70
MgO	15.73	15.29	18.07	16.05	16.71	16.22	4.69	8.46	9.62	10.05
K_2O	38.09	37.55	31.98	35.22	25.96	26.55	49.77	44.11	61.95	63.32
K	....	....	....	....	....	....	1.70	3.02	.94	1.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

In addition to the above, partial proximate analyses were made of the other samples of pease and beans, with the following results:

Proximate analyses of pease and beans.

Constituents.	Sugar Pease.		Extra Early Pease.		Golden Wax Beans.		Dwarf German Beans.	
	Best third.	Poorest third.	Best third.	Poorest third.	Best third.	Poorest third.	Best third.	Poorest third.
Water	7.68	5.97	8.24	8.45	7.23	8.02	6.57	8.00
Carbohydrates	64.20	63.43	63.70	63.54	63.42	61.08	64.99	63.12
Albuminoids	25.11	27.39	24.94	24.68	25.46	26.95	24.06	24.50
Ash	2.91	3.21	3.12	3.33	3.89	3.95	4.38	4.36
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

By reference to the above analyses, and those which have before been tabulated, it will appear that there are no greater differences than would necessarily arise from difference in the samples and the slight errors in analysis.

It is well established that during the period of development the proximate composition of the seed varies very widely; and should the light weight of the poorest thirds of the seeds analyzed be due to an imper-

fect development of these seeds, or to an arrest of their growth before complete maturity, this fact would be clearly manifest upon comparison of a large number of analyses, since by such comparison the slight errors of analysis would mutually correct each other, as would also any accidental differences in composition; while, on the other hand, any general principle tending to produce a difference in composition would the more clearly appear.

If now, for purpose of comparison, we group the carbohydrates of the ten analyses previously given, as also the albuminoids, we may then compare readily the entire eighteen analyses.

Representing, then, the amount of each proximate constituent in an individual seed from the best third by 100, we have the following results representing the amounts respectively of each constituent in the individual seed from the poorest thirds:

Percentage of each proximate constituent in the individual seed of poorest thirds, that in best thirds being 100.

Constituents.	Maize, Stowell's Evergreen.	Maize, Improved Prolific.	Maize, Compton's Early.	Pease, Kentish Invicta.	Pease, Extra Early.	Pease, Sugar.	Beans, Lima.	Beans, Golden Wax.	Beans, Dwarf German.	Average of all.
Water	64	59	83	66	79	55	74	82	82	71.6
Carbohydrates	68	68	80	69	77	70	70	71	65	71.0
Albuminoids	65	63	77	72	76	77	65	78	68	71.2
Ash	67	57	75	80	82	73	65	75	67	71.8

In the same manner, by comparing the full analyses given of the ashes of the first ten samples, it will be found that while certain constituents of the ash necessarily vary according to the mode of preparing the same, those two constituents which are most important, and which are present in greatest quantity, viz., potash and phosphoric acid, stand in the same ratio as the organic proximate constituents, *i. e.*, the amount of potash and of phosphoric acid present in a single seed of the poorest third of either of these ten samples analyzed averages exactly 71 per cent. of the amount present in a seed from the best third.

The conclusion, then, from these results is that the young plant would receive from the better seed the same kind of food for its early development and about 40 per cent. more of it than from the poorer seed.

It is also shown that the entire amount of the several seeds submitted to analysis were mature seeds, as, indeed, to the eye they appeared to be, differing only in their relative size; but it is highly probable that this difference alone would suffice to produce the most marked contrast between the plants produced from the better and poorer seed.

Along with these analyses above recorded, it was proposed to conduct some experiments in the field, and to this end seeds from each of the several samples analyzed were planted, with the view of determining their relative crop-producing value; but just before the seed began to set upon the vines of pease and beans a heavy rain drowned out and beat down the plants so effectually as to render the experiment almost worthless. But throughout the entire period while the plants were growing, a glance would have sufficed to distinguish between those plants growing from the better and those from the poorer seed.

It is proposed, this coming season, to repeat these experiments in the

field, and there seems reason to believe that the results attained will fully accord with those rendered probable from the results of analysis.

It is obviously true, and has been proved so by experiment, that even under-sized seed may, in fertile ground, produce well-developed plants; and, indeed, it appears to have been demonstrated that "the vigorous development of plants depends far less upon the size and weight of the seed than upon the depth to which it is covered with earth, and upon the stores of nourishment which it finds in its first period of life," but there still appears to remain, as an open question of very great practical importance, the comparative value of fully developed and imperfectly developed seed, under the ordinary conditions of moisture, fertility, &c.

EXPERIMENTS IN MANUFACTURE OF TEA.

During the past year several experiments have been made in the laboratory of the department in the preparation of tea from leaves grown in this country.

A preliminary experiment was made with leaves grown upon the department grounds, and the resulting product was a tea which, in appearance at least, left nothing more to be desired, it resembling the choicest varieties of black tea.

The tea was prepared from the fresh leaves according to the following process:

1. The freshly picked and tender leaves were first placed in a common sieve, which was placed over a tin-pan of boiling water, and were allowed to remain until thoroughly wilted.
2. The wilted leaves were then wrapped up in a coarse linen cloth, and wrung out by twisting the cloth.
3. The leaves, after this wringing, were then placed in a tinned iron pan, which was placed over a fire, and the leaves were briskly stirred about and rolled between the hands during this "firing" process until they became brittle.

The leaves, subjected to the above process, were weighed after each operation, and the loss of weight during the successive steps in the process were as follows:

	Young leaves from the department grounds.	Older leaves from Windsboro', S.C.
	Per cent.	*Per cent.*
Loss by steaming	11.33	4.46
Loss by wringing	6.88	7.81
Loss by firing	61.37	54.68
Total loss	79.58	66.95
Tea	20.42	33.05
	100.00	100.00

The quantitative results obtained from the first experiment with the young leaves are identical with those reported in those countries where this industry flourishes, viz., one pound of tea from five pounds of leaves.

Besides the two experiments already reported, there were made nine others, from leaves received from Mr. J. W. Pearce, Fayetteville, N. C.,

and from Miss McFall, High Shoals, S. C., during the month of May. These lots were from 1 to 8 pounds each. In each of these samples received the leaves were quite unsuitable for the preparation of tea, owing to their maturity, as will be evident from their size, which was from 2 to 3 inches in length by one inch in width. Owing to this, it was found quite impossible to roll the leaves, and the teas made from them were said to resemble the "flat-leaf teas" of China and Japan, called by the Chinese Bonketis, and by the Japanese Twankees, said to be used by the natives of these countries, but never exported.

Owing to the impossibility of manipulating these leaves, on account of their age and toughness, several modifications were made in the process of manufacture, but the results were unsatisfactory, showing that it is important that the leaves be plucked while they are still young and tender.

OIL FROM TEA SEED.

A small quantity of oil expressed from tea seed was submitted for examination.

The oil possesses a light yellow color, is faintly acid in reaction, and has a slight odor from the admixture of a trace of a volatile oil.

Its specific gravity at 28° C. was .9078. It is a non-drying oil and well adapted for lubricating light machinery, but with too little body for heavy machinery.

TEA-SEED HULLS.

The use of a decoction of tea-hulls being common in certain localities as a remedy in cases where quinia is generally employed, led to an examination of the hulls to determine the presence of any alkaloid, but, with the exception of a small quantity of theine, nothing was found of therapeutic value.

EXAMINATION OF SOPHISTICATED TEA.

A sample of so-called tea was submitted for examination by the Health Officer of the District of Columbia, it having been seized under the suspicion that, from the low price at which it was offered for sale, it was not a genuine tea. In appearance it closely resembled a good specimen of gunpowder tea. An examination and analysis fully confirmed the suspicions concerning its character. It contained nearly twice the normal amount of ash, there being present 10.06 per cent. This ash was composed largely of sand, and the portion soluble in acid consisted chiefly of iron, alumina, and lime.

The magnet removed numerous small grains from the tea, which appeared to be bits of magnetic iron. Upon passing the tea over a fine sieve there was removed a fine powder which, under the microscope, showed blue grains, which proved to be Prussian blue.

Upon boiling the tea in water there were found but few perfect leaves, and these proved to be other than leaves of the tea-plant, but the mass proved to be a collection of broken stems and fragments of leaves.

Only a trace of theine was present, and there was no doubt but that the so-called tea was a sophisticated product, intended and well calculated to deceive the ordinary purchaser.

It hardly seems probable that this is an exceptional case, and doubtless careful search would result in the detection of many similar products sold as tea in the market.

TEA AND COFFEE SUBSTITUTES.

During the past year there have been received at the department several substitutes for tea or coffee, in more or less general use in the several localities whence they came. None of these possessed any chemical properties or botanical relations to either tea or coffee, but in some cases an accidental resemblance could be seen, which, perhaps, has chiefly accounted for their use among the common people.

1. First among these may be mentioned the so-called "Poor Man's Coffee," received from John Jay Lewis, Fulton, Ark. This consists of the seeds of the *Cassia Occidentalis*—*Wild Senna*—natural order, Leguminosæ.

These seeds contain small amounts of a volatile oil and of a fixed oil; a purplish-red coloring matter, soluble in alcohol, but insoluble in ether, water, and acidulated water; a soluble albuminoid; a very large proportion of mucilaginous matter; a trace only of starch; also water, ash, and cellulose. The following determinations were made:

	Per cent.
Water at 110° C	6.83
Oils	4.00
Soluble albuminoid	7.06
Coloring matter	4.25
Ash	4.04
Mucilage, cellulose, starch	73.82
	100.00

When roasted the seeds have an odor resembling somewhat that of roasted coffee; and this odor seems to be due to partial volatilization of the oil and charring of the mucilaginous matter. These seeds are frequently used in Germany to adulterate coffee. (Am. Jour. Pharm., June, 1879, p. 303; Pharm. Ztschr. f. Russl., March 13, 1879, p. 116, from Chem. Ztg.)

2. "*Bush Tea*," received from Alphonso Taylor, United States consular agent, Port Elizabeth, South Africa. The absence of flowers or fruit in the sample made its botanical identification impossible. The leaves contain about five per cent. of resin, a volatile oil possessing an agreeable fruity odor, considerable tannin, gum, and chlorophyll. No theine or other alkaloid was present. The taste of its decoction is doubtless due to the tannin and volatile oil present.

3. "*Mountain Tea*," or, as it is locally known, "*Blue Mountain Tea*," received from Nathan Dundoro, Philadelphia, Pa. This tea is said to have been collected and used for very many years by the common people of Berks and adjacent counties of Pennsylvania. It is the *Solidago odora* or Sweet-scented Golden Rod. Its infusion is rather different from tea, but is quite agreeable in taste and odor. The volatile oil present doubtless gives it these peculiar properties. A full account of this plant is given in the United States Dispensatory.

4. "*Native Tea*," received from Dr. George H. Waddell, Greenwood, S. C., is *Sida stipulata*, Nat. Ord., *Malvaceæ*. No theine or other alkaloid is present, and its decoction has very little resemblance to tea.

5. "*Yaupon*," *Ilex cassine*, received from Robert Chisholm, Charleston, S. C., is of the same family as the Paraguay Tea, Mate, *Ilex Paraguayensis*, and like it contains a little theine, volatile oil, and tannic acid. Its infusion is a very good substitute for tea. An analysis may be found in the monthly reports of this department for 1872.

6. "*Common Gromwell*," *Lithospermum officinale*, Nat. Ord., *Borragenaceæ*, received from Governor J. B. Wakefield, Minnesota. This plant

gives an infusion much resembling tea both in odor and taste. It seems to contain no alkaloid, although the amount for examination was quite small. The odorous principle of the plant is extracted by ether, and is a volatile oil. The presence of a small quantity of tannic acid gives an astringent taste to the infusion of this plant.

7. "*Labrador Tea*," *Ledum latifolium*, received from James W. Taylor, United State Consul, Winnipeg. This plant contains no theine or other alkaloid, nor does its infusion very closely resemble tea.

In all of the substitutes for tea and coffee thus far examined, the properties that most commend them seem to be due to the volatile oil and tannin invariably present. In fact, these are the constituents in tea which most modify its taste and odor. The theine present in good teas seems to bear little relation to their commercial value or to their acceptability to consumers.

EXAMINATION OF LEAVES OF "INK-BERRY" (ILEX GLABRA), RECEIVED FROM S. W. CARSON, FORT MEADE, FLORIDA.

Volatile oil, chlorophyll, white wax, yellow resin	7.6
Ilicin (the bitter principle)	36.09
Tannic acid	5.16
Yellow resin (ilixanthin?)	9.84
Sugars	5.73
Gum (and ilicic acid?)	3.42
Starch and isomers	5.92
Red substance, soluble in alkalies	2.50
Cellulose	7.97
Albuminoid matter	5.60
Ash	2.54
Moisture	7.11
	99.50

No alkaloid was found.

The medicinal value of these leaves probably depends very largely upon the bitter principle (ilicin), which is present in large amount. It is very probable, also, that the proportions both of ilicin and ilixanthin may vary greatly with the time of the year when the leaves are gathered. The leaves of *Ilex aquafolium*, a closely related plant, contain in August large amounts of ilixanthin, and in January very small amounts.

The leaves of *Ilex aquafolium* have been highly praised by French practitioners as of value in the treatment of intermittent fevers, and it seems probable that these leaves of *Ilex glabra* may have similar properties; in chemical composition they are very similar.

EXAMINATION OF LEAVES OF TURNERA APHRODISIACA (VASEY AND WARD).

These leaves have an aromatic odor, resembling turpentine, a pungent and slightly bitter taste; they contain no distinct starch granules, but there is a small amount of amorphous substance which is colored blue by iodine. The proximate constituents determined were: a soft resin, soluble in ether; a volatile oil; chlorophyll; a hard brown resin, insoluble in ether, soluble in absolute and eighty per cent. alcohol; sugar and red coloring matter; a peculiar tannic acid; a bitter substance; gum; starch isomers; albuminoids; cellulose, and humus-like substances soluble in alkaline hydrates. The amount of gum is quite large. The bitter substance is now being investigated. The albumen was determined from total nitrogen.

Analysis.

Moisture, at 115–125° C	9.06
Ash, by combustion	8.37
Chlorophyll, soft resin, volatile oil	8.06
Hard, brown resin	6.39
Sugar, and coloring matter	6.42
Tannin	3.46
Bitter substance	7.08
Gum	13.50
Starch isomers	6.15
Acid extract	2.48
Alkali extract—humus-like substances	7.54
Albuminoids	14.88
Cellulose	5.03
	98.42

ANALYSIS OF FLORIDA MOSS, TILLANDSIA USNEOIDES.

An analysis of the so-called Florida Moss was made for the purpose of learning whether in its composition it bore any resemblance to the Reindeer Moss, *Cladonia rangiferina*, which latter is in Sweden subjected to fermentation, with the production of alcohol.

An analysis of the Florida Moss gave the following results for the dry plant:

	Per cent.
Chlorophyll, xanthin, and oil	3.6
Wax	.8
Resin, out of ether extract	1.9
Resin, out of alcohol extract	2.9
Tannin-like body (acid)	6.9
Gum	5.6
Convertible (amylaceous) cellulose	22.1
Humic bodies	8.5
Albuminoids	3.9
Crude fiber	40.9
Ash	2.1
	99.2

The chlorophyll, xanthin, and oil included in the 3.6 per cent. mentioned, consist of the green coloring matter of the plant mixed with a larger proportion of a yellow coloring matter (xanthin), which is noticed on crushing the fresh plant, and a little oil.

Under wax is included that substance extracted by warm ether, soluble in hot alcohol, but insoluble in cold ether and alcohol.

The resin from the ether extract is soluble in cold ether sparingly, freely in cold alcohol. It is a light-yellow brown, apparently somewhat crystalline body. It is very freely soluble in ammonia, with a brilliant brownish-yellow color, and is precipitated by dilute hydrochloric acid.

Another resin is found in the alcohol extract. It is darker in color than the former resin; is less soluble in alcohol and ammonia. It gives with strong sulphuric acid a deep brown coloration. Both resins melt at low temperatures.

The portion of the alcohol extract soluble in water has an acid reaction, and gives many of the reactions characteristic of tannic acid, but the precipitates are much more soluble than those of tannin; that with ammonio acetate of zinc being easily soluble in water containing a few drops of ammonia. Iron salts do not give as deep a coloration as with tannin. No sugar could be detected in the plant. Starch, too, is absent, or only present in mere traces.

The aqueous extract contains a body possessing all the properties of a gum.

The cellulose convertible to glucose by boiling a few hours with 2 per cent. sulphuric acid seems to be quite constant. In two experiments the plant, after extraction with ether, alcohol, and hot water, gave, on boiling 2 hours with 2 per cent. acid, 21 per cent. amylaceous cellulose; on boiling 4 hours with 3 per cent. acid, 22.1 per cent.

The humic bodies include those substances soluble in ammonia water which are so little understood.

Albuminoids were determined, as usual, with soda lime.

The residue, after extracting the plant with ether, alcohol, hot water, dilute acid, and ammonia and potash, has been tabulated as crude fiber, and consists of cellulose, with a small amount of coloring matter.

The ash amounts in the specimen examined to only 2.1 per cent. of the dry substance, while Vaquelin found as much as 3 per cent. in the same plant when he examined it. This is undoubtedly owing to varied conditions of growth.

As a commercial substance the plant seems to possess no greater value than its present use as a fiber in cushions, packing, &c. For fermentation it presents few desirable qualities, no starch being detectable. The amylaceous cellulose is the only available substance, and this is not present in an amount large enough to make its application to this purpose profitable.

ANALYSIS OF THE REINDEER MOSS, CLADONIA RANGIFERINA.

An analysis of a specimen of this lichen gave the following results:

	Per cent.
Yellow coloring matter	.2
Usnic acid	2.9
Organic acid, insoluble in ether	4.7
Gum	1.0
Humic substances	1.1
Albuminoids	3.6
Crude fiber	5.6
Ash	1.0
Lichenin, moss starch (by diff.)	79.9
	100.0

An ether extract of the plant contains the yellow coloring matter and the usnic acid. The former is separated from the acid by its greater solubility in cold ether. The usnic acid which separates from ether and alcohol in fine sulphur-yellow crystals melts at 200° C., and thus corresponds with that of most observers, not, however, with the acid extracted by Stenhouse from this plant, and called by him β usnic acid, or cladonic acid, and which melted at 175°. It seems from the various observations that have been made, that the composition of the acid present is very variable at different periods of the plant's growth, at times being entirely absent, as found by Stenhouse (Liebig's Annalen 155B 55S).

The specimen under examination was collected in Sweden in 1866, and is consequently pretty old, but in the form in which it is applied in that country to fermentation for the production of spirit from the large amount of lichenin (moss starch) which it contains.

After the extraction with ether, 80 per cent. alcohol takes out with some difficulty about 4.7 per cent. of a mixture of organic acids, separable approximately by their varying solubilities in alcohol and petroleum naphtha. They were not more minutely investigated. Water extracts a small amount of gummy matter, and after extraction of lichenin

with strong hydrochloric acid and digestion with 2 per cent. sulphuric acid at a boiling temperature for a few hours, ammonia removes a little humus-like substance. The crude fiber still remains dark and contaminated with some substance which has been blackened by the action of the hydrochloric acid. Lichenin seems to form the largest part of the plant. It is easily converted to a sugar by boiling with acids.

A combustion with soda lime shows the presence of albuminoids to the extent of 3.6 per cent. of dry substance.

EXAMINATION OF "BONESET," (EUPATORIUM PERFOLIATUM.)

Boneset has long had the reputation in domestic medicine of being a good tonic, especially valuable in the spring. Physicians also have attributed to it virtue as a diaphoretic, expectorant, emetic, and anti-intermittent. Whether all claimed for it is true must be settled by the physician, but the present chemical examination has been undertaken with the hope of throwing some light upon the proximate principles to which are due the medicinal effects of the herb. Partial analyses have been made by W. Peterson (Amer. Jour. Pharm., 1851, XVII, p. 206), and M. H. Bickley (Amer. Jour. Pharm., 1854, XX, p. 495).

Probably the bitter principle is the only one of medicinal importance. It is a brown, uncrystallizable substance, soluble in water and alcohol, not soluble in ether. It was impossible to purify this substance well.

Upon evaporation of an alcoholic extract of the drug, a few white prismatic crystals were deposited; these crystals were difficultly soluble in hot alcohol, and insoluble in ether, water, dilute acids, and dilute alkalies. They seem, therefore, to be neither acid nor alkaloid, but rather of an indifferent character.

The drug seems to have very little volatile oil, although its odor may be accounted for by the small amount present. Starch is not abundant. The tannic acid found gave the usual reactions, except that it failed to precipitate tartar emetic from its aqueous solution. The albuminoids were calculated from total nitrogen multiplied by 6.25. It is impossible to say whether sugar was present in the substance, as the bitter principle would probably give similar reactions.

The following analysis is regarded as an approximation only, but care has been taken to eliminate all preventable errors:

Analysis.

	Per cent.
Moisture	9.17
Ash	7.51
Albuminoids	13.30
Resins and chlorophyll	15.15
Indifferent crystalline substance	2.87
Tannic acid	5.04
Bitter extractive	18.84
Gum and color	7.23
Starch isomers	12.47
Cellulose	9.32
Humus substances	traces.
Volatile oil	traces.
	100.90

ESTIMATION OF SAPONIN.

Determinations of Saponin have been made in two materials, viz., Quillaye bark (*Quillaya Saponaria*) and Lignumvitæ root bark (*Guaiacum officinale*), with the following result:

Quillaye bark	16.75 per cent. Saponin.
Lignumvitæ root bark	21.15 per cent. Saponin.

Messrs. McKesson & Robbins, of New York, have, however, tested these two materials practically, and conclude that for detergent purposes the Quillaye bark is worth three or four times as much as the Lignumvitæ bark.

This practical result is due, doubtless, in great part, to the great difficulty in extracting the Saponin from the Lignumvitæ bark, as in analysis it was found practically impossible to remove it completely, and the above results are therefore only approximate.

The percentages above given of Saponin are the averages from a large number of determinations, which in the case of the Quillaye were of very close agreement.

"LOCO," OR POISON WEED.

The following letter, accompanying a small parcel of the weed, was received, and the roots and leaves were submitted to an examination for the vegetable alkaloids, as the symptoms described resemble closely the effect of certain of these vegetable poisons, but none were found.

The plant is the *Oxytropis Lamberti*, one of the *Leguminosæ*, and reference has been made to it in a previous report (1874, p. 160).

A further examination will be made of the plant, and any facts concerning it are desired by the department.

An examination of this weed by Miss Catherine M. Watson, of Ann Arbor, Mich., is reported in the American Journal of Pharmacy, December, 1878. The plant was obtained from Rosita, Colorado, and she reports the presence in small quantity of an alkaloid and a resin. The dried root was taken by way of experiment in four forty-grain doses within one and a half hours, with no other perceptible effect than a slight smarting of the eyelids and slight colic pains. One and a half ounce of the fluid extract was given to a kitten two months old with no perceptible effect.

BOMBIC ACID.

A specimen of so-called bombic acid, being a secretion of the silkworm, was submitted for examination by the entomologist of the department.

This liquid was neutral to test paper. With alcohol a flocculent mass resembling mucilage was precipitated. The alcoholic filtrate was also neutral, and upon evaporation left a slight residue, nearly colorless, which under the microscope appeared like a few oil globules and a little wax.

From these reactions the so-called bombic acid appears to me a hypothetical substance.

COVERING OF EGGS OF INSECTS.

At the request of the entomologist, analysis was made of the white covering of the eggs of the *Corydalus cornutus* Linn., found upon oak leaves.

The powdered substance was treated with a mixture of alcohol and ether, and 11.14 per cent. of a white amorphous substance was extracted, insoluble in water, partially soluble in alcohol, and freely soluble in ether. In these respects and in its physical properties it closely resembled wax.

The amount of albuminoids calculated from total nitrogen was 28.60 per cent. The amount of ash was 1.83 per cent. The quantity of the substance submitted for analysis was too small to permit further determinations.

BAKING-POWDERS.

A sample of baking-powders has been submitted for analysis, the composition of which is as follows: 3 parts starch; 1 part bicarbonate of soda; 1 part alum.

The presence of alum in the so-called baking-powders of the market is almost invariable, and its use for this purpose has been almost universally condemned by those of the medical profession who have pronounced an opinion.

ARSENICAL PAPER.

A specimen of wall-paper was examined for arsenic, and was found to be one of the most poisonous papers of this class.

It certainly should be a matter subject to the careful supervision of our boards of health to prevent the sale of such papers, since repeated cases of arsenical poisoning have been produced by the use of them. The amount of arsenious acid present in a square foot of this paper was found to be 4.73 grains.

EXAMINATION OF AMERICAN AND FOREIGN BUTTERS AND OLEOMARGARINE.

The examination of the American and foreign butters was made with a view of discovering if American butter could not be shipped to South America and arrive there in as good condition as foreign-made butters.

The butters analyzed included the following, viz: One specimen each of Danish, Swiss, and French butter, received from J. B. Thompson, of 54 Broad street, New York City; one specimen each of Iowa butter of second quality, New York dairy butter, and oleomargarine bought in Washington markets. To these are added the analyses of two specimens of oleomargarine received from House Committee for District of Columbia.

No.		Fats.	Casein.	Salt.	Sugar.	Water.	Total.
1	Danish	90.94	1.46	2.75	.52	4.17	99.84
2	Swiss	87.73	1.91	2.50	.65	6.35	99.14
3	French	87.36	.86	4.74	.18	6.80	99.94
4	Iowa	86.09	1.82	2.76	.13	9.05	99.85
5	New York	83.92	2.23	4.10	1.82	7.66	99.73
6	Oleomargarine	84.92	1.19	6.65	.60	5.89	99.25
7	Oleomargarine	84.72	.69	6.21	1.33	7.19	100.14
8	Oleomargarine	86.28	.59	5.05	1.26	6.85	100.03

In animal fats the fatty acids insoluble in water form from 93.5 to 96 per cent., while in true butter the insoluble fatty acids average from 85.5 to 87.5 per cent. of the butter fat, and never exceed 89.6 per cent. Hence, since in the sample of oleomargarine No. 6 the fatty acids equal 95.96 per cent. of the fats, it will be seen that this sample of oleomargarine was made from animal fats to which had been added a little milk in the process of manufacture.

In washing a true butter with water the water becomes milky, and a portion of these washings under the microscope shows a vast number of fat globules present in the buttermilk contained in the butter. The specimens of oleomargarine Nos. 7 and 8, on the contrary, give a nearly clear water by washing, and this water is almost entirely destitute of fat globules, except that, since milk is used in their manufacture to a limited

extent, there was found a comparatively small number of fat globules in the washings of these specimens of oleomargarine.

The sugar present in analyses Nos. 5, 7, and 8 indicates beyond doubt the addition of this substance to the butter and the samples of oleomargarine. The small quantity in the other samples may be due to the products of decomposition in the butter analyzed, which products deported themselves in a manner similar to sugar in their effects upon the reagents used in the analysis.

These analyses show the American butters to be fully as good as the foreign butters, and, in fact, the specimens of French, Danish, and Swiss butters were in such condition of rancidity when received that they would hardly count as third-rate butters in our markets.

There appears to be no reason to doubt that good American butters could compete favorably in the South American market with either of those examined.

ANALYSIS OF CORN-COBS.

A sample of corn-cob meal received from Henry C. Hallowell, Sandy Spring, Md., gave, upon analysis, the following results:

	Per cent.
Water	14.42
Oil	.72
Sugar	2.62
Zein	2.33
Gum	1.07
Cellulose (soluble) and starch	41.62
Cellulose	36.10
Ash	1.12
	100.00

As will be seen from the above analysis, there are present several constituents in appreciable quantity of acknowledged nutritive value, while under the head of soluble cellulose and starch, constituting 41.62 per cent., we have a substance which, in all probability, may undergo digestion and assimilation, but concerning the real function of which little at present is known, and repeated and careful food experiments with the live animal are needed.

It is, however, of importance to add that a large percentage of our best grasses consists of this same form of cellulose, which is not starch nor common cellulose, but a substance readily dissolved by weak acid solutions. There is but a small quantity of starch present, as is also true of our common grasses. The question as to the real food value of corn-cob meal is one frequently under discussion, and it is greatly to be desired that experiments be made and the results recorded.

From the above analysis it appears to be established that corn-cob meal, instead of being a worthless addition to cornmeal, does possess a positive nutritive value of its own, and it may be that this value is very much greater than is commonly supposed.

ANALYSIS OF BREWERS' GRAINS.

A sample of brewers' grains received from Francis J. Geis, Dobbs Ferry, New York, was submitted to analysis with the following results:

For purpose of comparison an analysis of brewers' grains published in the tables of Professors Wolff and Knop is also given, calculated to the same percentage of water found in the sample analyzed from Mr. Geis, from which it will be seen that the composition is a pretty constant one.

Analyses of brewers' grains.

Constituents.	Sample received from F. J. Geis.	Analysis in tables of Wolff & Knop.
	Per cent.	*Per cent.*
Water	10.24	10.24
Ash	2.70	4.58
Cellulose	14.88	22.16
Albuminoids	21.66	17.57
Sugar	4.31	
Gum	6.94	39.72
Starch	32.37	
Fats	6.66	5.73
Loss	.24	....
	100.00	100.00

EXAMINATION OF CALIFORNIA TOBACCO.

A sample of tobacco was received from J. C. Davis, Los Angeles, Cal., for examination. The analysis was limited to the determination of the alkaloid nicotine.

The air-dried sample contained 4.04 per cent. of nicotine, an amount about midway between the weak tobaccos of Havana and the stronger ones of Virginia and Kentucky.

The specimen analyzed possessed good color and good smoking qualities, and was apparently a superior tobacco in all respects.

PLEURO-PNEUMONIA—ANALYSIS OF MILK OF COW.

A microscopical and chemical examination of the milk of a cow suffer- from pleuro-pneumonia was made with the following results: The cow was a grade short-horn, owned by Thomas Carroll, of Alexandria, Va.

Under the microscope a sample of the milk showed an apparent deficiency in fat globules, and the globules, instead of being uniformly distributed through the liquid, appeared gathered into large groups, with spaces between comparatively free from globules.

There was nothing, however, of a clotted appearance in the milk (although a sample of the cream under the microscope afterwards did present this clotted appearance), but there was in the milk a very marked difference in the distribution of the fat globules.

The specific gravity of the milk at 15° centigrade (59° F.) was 1.033.

The composition of the milk was as follows:

	Per cent.
Water	86.42
Fat	2.28
Solids not fat	11.30
	100.00

A detailed analysis gave the following results:

	Per cent.
Water	86.42
Fat	2.28
Casein	4.60
Albumen	1.23
Sugar (by difference)	4.63
Ash (soluble .213, insoluble .626)	.84
	100.00

There are several abnormal points to be observed in the above analysis, viz.:

1. The large amount of *albumen* which is never present in so large quantity in normal milk, except shortly after the birth of the calf, at which time the milk is generally regarded as unfit for use.
2. The low amount of fat, which is fully *one per cent.* below the average.
3. The relatively small quantity of water and large quantity of the other constituents of the milk.

The results of the analysis fully confirmed the predictions of Professor Law in his pathology of the disease, upon the advice of whom the examination was made.

MINERAL-WATER ANALYSIS.

There have been made during the past year ten complete analyses of well and spring waters, but as the results were of local interest they are not here given. In one case, however, there was evidence of contamination through either stable, privy, or cesspool, and in two other cases there was present so large an amount of organic matter in a state of decomposition as to render these waters totally unfit for use. In still another case, the presence of over 100 grains of mineral matter to the gallon gave the water properties which warranted the local reputation the spring possessed for its medicinal virtue.

SOIL ANALYSES.

Twelve soils have been analyzed, but the results obtained have little general value. It would, perhaps, be advisable that systematic work be done in this direction, by selecting for analysis soils from different points along the lines of our western railroads, and thus obtaining results which might indicate, approximately at least, the comparative value of these lands; but for such an extended work, no matter how desirable, there is at present no sufficient force provided, and no room for carrying on a work of such extent and of such possible and probable value.

Analyses of three specimens of soil from the Red River of the North gave the following results:

A. Surface soil.
B. Subsoil.
C. A surface soil at times absent, but when present indicating a good soil for wheat.

Constituents.	A.	B.	C.
Organic	6.11	2.51	2.08
Water	3.44	16.77	11.18
Insoluble clay, &c	63.12	34.48	32.61
Silica soluble in $HNaO$	14.75	15.93	9.32
Silica soluble in HCl	.09	:08	.14
CO_2	1.19	10.00	6.78
SO_3	.06	1.18	14.88
P_2O_5	.101	.076	.071
Fe_2O_3	5.73	1.82	1.79
Al_2O_3	.92	4.33	1.28
MnO	.11	....	....
CaO	2.64	9.16	17.50
MgO	1.32	3.57	1.66
K_2O	.46	.17	....
Na_2O	.01	.05	.12
	100.05	100.13	99.41

Duplicate determinations of P_2O_5 gave for A .104 per cent., B, .085 per cent.

Duplicate determinations of SO_3 and CaO in sample C gave 14.99 per cent. SO_3, and 17.52 per cent. CaO.

The above analysis shows in this soil C nearly *one-third its weight of gypsum* (31.99 per cent. $CaSO_4$, $2H_2O$), and 15.4 per cent. of carbonate of lime.

The analysis was conducted as follows: Twenty grams of fine soil were treated with 300 $\overline{cm}^3$ of hydrochloric acid, sp. gr. 1.115, for five days at 100°, the insoluble matter filtered off, ignited, and weighed, and in it the SiO_2 soluble in $NaOH$ determined. In aliquot parts of the solution, Fe, Al, Ca, Mg, and SO_3 were determined.

Another twenty grams, after ignition, were treated with HNO_3, sp. gr. 1.2, for five days, filtered, and the filtrate divided in halves, in one of which P_2O_5 was determined by Sonnenschein's method; in the other the alkalies by conversion to carbonates with oxalic acid.

In a third portion CO_2 was determined in one of the usual forms of apparatus by loss of weight.

In a fourth, water was found by drying for two days at 120° to a constant weight, and the organic matter by ignition and subsequent treatment with carbonate of ammonia.

Two specimens of earth from Yakima City, Washington Territory, have the following composition:

Constituents.	First.	Second.
	Per cent.	*Per cent.*
Water and organic matter	7.37	5.51
Insoluble in HCl	45.15	53.02
Fe_2O_3 and Al_2O_3	4.55	Traces.
CaO	1.69	1.00
MgO	Traces.	.19
Na_2O	17.01	18.55
SO_3	22.51	21.35
Cl	1.28	.86
	99.56	100.48

As will be seen from the above analyses, these samples are practically the same thing, and contain 38 and 40 per cent. respectively, of anhydrous sulphate of soda.

The following letter accompanying the samples will give details concerning this peculiar substance:

YAKIMA CITY, WASHINGTON TERRITORY.

COMMISSIONER OF AGRICULTURE:

SIR: I mail you to-day a parcel containing two samples of "alkali dust." This dust is found all through this country, from the Cascade Range on the west to the Rocky Mountains on the east, on tracts varying in size from a few acres to several thousand, covered in dry weather with this grayish substance, from the thickness of paper to a half inch in thickness. In rainy weather the earth seems to be covered with potash. When water standing in little holes or puddles dries down a little it has the color of strong lye leached from wood ashes, and feels slippery to the hand. The taste is like salt and soda mixed. Cattle seem fond of it in place of salt, and actually refuse salt. There are places east of Columbia River where it is found an inch thick, and travelers sometimes use it in making bread in place of saleratus. These alkali lands are almost useless for cultivation.

Yours, truly,

JAMES E. COOK.

ANALYSES OF MARLS.

There have been made analyses during the past year of sixteen specimens of marl, and reports have been forwarded to the parties sending

the samples for examination. In no case have any proved of value as fertilizers from the presence, in appreciable quantity, of either phosphates or potash.

The samples have proved generally to be mainly calcareous, resulting from shells more or less finely divided; and in some cases it has been advised to test the marls by applying them for experiment as a top dressing to certain lands.

Silicious marls.

Two specimens proved to be very good kaolins, and if present in quantity may prove valuable deposits.

The analysis of one of these two samples is given below, this specimen having been received from E. R. True, of this city:

	Per cent.
Water	3.85
Silica	72.70
Alumina	20.36
Iron oxide	4.37
Magnesia	.27
Lime	none.
	101.55

Gypsum marl.

A sample of marl, said to exist in very great quantity and readily accessible on the shores of Lake Jessup, Florida, gave upon analysis the following:

	Per cent.
Water and organic matter	6.36
Sand and clay	68.94
Gypsum ($CaSO_4$, 2 H_2O)	13.79
Limestone ($CaCO_3$)	3.77
Iron and aluminium oxides	7.14
Phosphoric acid	Traces.
	100.00

The crystals of gypsum are easily discernible to the eye, and the large percentage of this fertilizer makes this deposit of very great value to the farming interests of that section.

ANALYSES OF LEACHED WOOD AND COAL ASHES.

Two specimens of ashes have been analyzed—the one obtained from the leached chips of logwood used as fuel, and the other from Cumberland coal. In neither of the above was there found an appreciable quantity of potash, and only .39 per cent. of insoluble phosphoric acid in the coal ashes, and the fertilizing value which was ascribed to each of these by those requesting analysis, was doubtless due to their mechanical effect upon the soil.

BAT GUANOS AND CAVE EARTHS.

The deposits of bat guanos appear to have been pretty thoroughly explored, and there have been received during the past year but four samples, and these from very limited deposits. One of them, however, consisted almost entirely of bat excrement, while the others were in part composed of this material, but mainly of earth containing but little fertilizing value.

Owing to the small quantity of each found in these several deposits, complete analyses were not made of the samples received.

A specimen called bat guano, received from Hon. Joseph Jorgensen, had the following composition as shown by partial analysis:

	Per cent.
Water	6.31
Organic matter	.90
Inorganic matter	92.79
	100.00

There was present .49 per cent. nitrogen, equivalent to .59 per cent. of ammonia, and 6.46 per cent of phosphoric acid, .82 per cent. of soda, .46 per cent. of potash.

SLATE-DUST FERTILIZER.

A specimen of slate dust, received from George D. Spencer, Fair Haven, Vt., contained 4.95 per cent of potash, and nothing else of acknowledged fertilizing value, and yet, owing to the fine state of subdivision, it is possible that this small amount of potash may be slowly available to the growing plant; still the commercial value of this fertilizer scarcely can exceed one or two dollars per ton.

COMMERCIAL FERTILIZERS.

Under this head may be comprised analyses of three samples of sulphate of ammonia, each of which was found to be as represented, and fully worth the price for which they were sold.

Three fertilizers have been examined, viz:

1. Loess superphosphate, from Anthony Pirz, Long Island City, N. Y.
2. Windsor Guano Company phosphate, from J. L. Crouse, vice-president of the company, Washington, D. C.
3. Superphosphate, received from E. C. Belt, Rockville, Md., said to be "Eureka."

Analyses of these are given below:

Constituents.	Loess superphosphate.	Windsor Guano Company.	E. C. Belt, Eureka(?).
	Per cent.	*Per cent.*	*Per cent.*
Soluble phosphoric acid	9.69	Trace.	....
Reduced phosphoric acid	....	1.06	.75
Insoluble phosphoric acid	....	Trace.	....
Potash	.57	.14	.74
Nitrogen	.14	.13	2.04

By adopting the scale of prices for the above constituents which has been used by T. L. Janes, the commissioner of agriculture for Georgia, in estimating the value of those fertilizers sold in that State, and which scale of prices appears reasonable, viz., 18 cents per pound for nitrogen, 12½ cents per pound for phosphoric acid, and 8 cents per pound for potash, it will be seen that a ton of 2000 pounds of the above fertilizers will be worth as follows:

Constituents.	Loess.	Windsor.	E. C. Belt.
Phosphoric acid	$24 23	$2 65	$1 88
Nitrogen	50	47	7 34
Potash	91	22	1 18
Total value per ton	25 64	3 34	10 40

From the above it will, I think, appear evident that there is little work more desirable to be done in the interests of agriculture than to protect the farmer from fraud in the matter of fertilizers. Their use, especially in the older States, has become a necessity, and their sale aggregates millions of dollars annually. At the present we appear to be passing through an experience similar to that of England and Germany, but it is to be hoped more rapidly.

It must be apparent at a glance that there is in the manufacture and sale of these fertilizers room for most gigantic fraud, and indeed evidence is not wanting to show that in every country, not even excepting our own, men have been found unprincipled enough to avail themselves of these advantages.

Chemical analysis can alone suffice to determine the composition and value of a fertilizer, and this involves considerable expense.

Shortly after the introduction of commercial fertilizers in England the most excessive frauds were practiced upon the farming community, and even so late as 1855 Professor Voelcker declared "that if ever there was a time when the agriculturist had need to exercise special caution in the purchase of artificial manures that time is the present, for the practice of adulterating standard fertilizers, such as guanos, superphosphates, &c., has reached an alarming extent."

At this present time, however, in England and upon the Continent, these manufactories have for the greater part passed into the hands of intelligent capitalists, who are content with fair and legitimate profits, and for the interest of whom it is to maintain a respectable standard for their products.

In our own country the same is to a great extent true, but by no means is it universal. During the past few years there have been enacted in nearly all of the older States stringent laws regulating the sale of these fertilizers, and the trade has been watched over by legally constituted inspectors.

The result of this has been that with the increased intelligence of the people concerning the function and character of these fertilizers, together with a rigid enforcement of the laws regulating their sale, their intrinsic value has very greatly increased, and the worthless frauds have been withdrawn from the market.

But the universal experience in England, Germany, and this country has been that this supervision must be constant, since the incentive to fraud is so great and its consummation so easy. Very many leading agriculturists of the country have suggested as an important feature of the work which should employ the Chemical Division of this department the supervision and control of this matter of commercial fertilizers. To quote from many expressed opinions concerning this matter, Hon. Harris Lewis, late president of the New York State Agricultural Society, writes as follows:

> After giving this subject what attention I could, I have come to the conclusion that there is no way in which the Department of Agriculture can aid the farmers of this country more than by a careful analysis of the commercial fertilizers sold on the market. The use of these fertilizers has become a necessity in the older States, a necessity which is to increase from year to year. There is not one farmer in five hundred thousand able to tell their value except by actual trial, and that must be made after his money is gone. I hope the Department will be able to aid us in this matter.

And President Phillips, of the University of North Carolina, says:

> It seems to me that the Department will do our farmers most good by showing them how to defend themselves against fraud in what they buy, as seeds, fertilizers, &c.

As evidence that an intelligent supervision of this trade in commercial fertilizers has always proved effective, and forever will prove so, reference is made to the results in the State of Georgia, where, in the year 1874–'75, the ratio of intrinsic value of the several fertilizers sold in the State, to their selling price, averaged $36.68 to $50.38 or 100 to 137, while the following year, 1875–'76, this ratio was $44.83 to $46.65, or 100 to 104. And this result was due wholly to careful chemical supervision, and the estimated saving to the State by this marked improvement in the character of these fertilizers amounted in one year to $559,168.

It is also worthy of note that the acreage yield of corn increased the second year 34 per cent., while the cost of production per bushel was estimated to have been 13 per cent. less than it was the year before.

The same results have been observed in every section where a similar supervision has been exercised, and it is safe to assert that no other means of protection to the farmer will avail than chemical analysis.

Reference has been made to the general want of information concerning the fundamental principles of agricultural chemistry. This is well illustrated in the following subject submitted for investigation:

SILICIOUS DIATOMS.

A small bottle containing what purported to be the ash from the stalks of grain, and which was said to be made up mainly of silicious diatoms, was sent for examination.

Under the microscope it proved to be a very good preparation from the straw of wheat or some other grain, and showed admirably the peculiar spiral cells and dotted ducts, which might readily be mistaken by the unpractised eye for the markings upon certain species of the diatomaceæ. This error of observation has led parties to place upon the market one form and another of the so-called silicated fertilizers, consisting to a great extent of silicious infusorial earth, beds of which are found in several sections of the country. It is supposed by those honestly endeavoring to effect the sale of this fertilizer (if such there are) that, inasmuch as in the stalks of the grasses, cereals, &c., there is found a large amount of silica, this silica is taken up bodily by the plant, and that in this minute state of subdivision which this infusorial earth presents, every facility is afforded the plant for securing an abundant supply.

But there is no reason for the belief that the presence of silica is other to than adventitious and accidental in the plant. There is every reason believe it of the nature of an excrementitious product, which the plant has been during its growth endeavoring to eliminate. Its presence quantitatively is proportioned to the maturity and age of the plant containing it, and, even if necessary, there is rarely, if ever, a soil in which it is not found in quantity more than sufficient for the plant.

There is no shadow of reason for the belief that the plant ever takes up food by its roots other than in solution, and the assertion, therefore, that these silicious skeletons of diatoms have been or may be bodily appropriated as food and deposited in the stalk, as they are supposed to be found, is simply preposterous, and that it should have gained even limited credence is due only to the want of accurate information concerning the structure of plants as seen under the microscope, and ignorance concerning the fundamental principles of plant-food and the conditions of its assimilation.

But that this general lack of accurate information does not especially characterize the agriculturist, attention may be called to another matter which has been subjected to examination.

THE COAL ECONOMIZER.

This substance has been during the past winter widely advertised and abundantly used in the hope that at least some one of the many statements concerning it might be true, but in fact it is a downright swindle, and could only have succeeded through a general ignorance as to the nature of heat and combustion, and the universal desire to economize in the use of fuel.

An analysis of the substance shows it to be composed of—

	Per cent.
Common salt	60. 00
Glauber salt (anhydrous)	39. 45
Carbonaceous matter	. 55
	100. 00

It appears to be, and doubtless is, simply a crude salt cake, absolutely valueless for all the purposes for which it was sold, and costing at best possibly a cent a pound, but furnished at 25 cents per pound.

That such an imposition could be possible is almost a disgrace to our intelligence, and that it is practiced upon a community should be made a criminal offense.

SUBSTITUTE FOR PARIS GREEN.

A specimen of "London Purple," a residue from the manufacture of aniline colors, received from ——— ———, and which, it is said, may be sold at six cents per pound, was analyzed and found to contain:

	Per Cent.
Rose aniline	12.46
Arsenic acid	43.65
Lime	21.82
Insoluble residue	14.57
Iron oxide	1.16
Water	2.27
Loss	4.07
	100.00

As will be seen, this is mainly arseniate of lime, and the presence of this soluble and intense color would serve to show the presence of the poison wherever used, as well as to show the necessity of further application if washed away by rain. The low price would certainly warrant experiment to see whether it could not be substituted for Paris Green, now so generally used to destroy the Colorado beetle which infests our potato fields.

ANALYSES OF LIME.

Six samples of lime, received from John H. Studer, Halltown, Jefferson County, West Virginia, were analyzed for the purpose of determining their relative purity. The following are the analyses:

Constituents	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Lime	74. 23	69. 76	79. 87	88. 44	86. 97	89. 93
Magnesia	2. 44	12. 12	. 66	. 51	3. 35	2. 15
Alumina and iron oxide	1. 50	6. 44	2. 85	6. 13	4. 55	5. 77
Residue, insoluble	3. 93	2. 80	. 09			
Water and carbonic acid	17. 90	8. 88	16. 53	4. 92	5. 13	2. 15
	100.	100.	100.	100.	100.	100.

The first three samples received were partially air-slaked from exposure, as the results show. No. 2, from the large amount of magnesia present, would doubtless prove injurious if applied to the soil in quantity.

ANALYSIS OF COAL FROM SHENANDOAH VALLEY.

Specific gravity, 1.46.

Moisture	.33
Ash	17.31
Bituminous matter	11.28
Coke	71.08
	100.00

Total sulphur, 1.51 per cent.

ANALYSIS OF HYDRAULIC LIMESTONE.

A specimen of limestone, from W. F. Stiles, Volcano, West Virginia, gave upon analysis the following results:

	Per cent.
Insoluble in acid, 27.49 per cent., consisting of:	
Silica	18.68
Alumina	6.23
Iron oxide	1.63
Manganese oxide	.64
Lime	.31
Soluble in acid, 72.51 per cent., consisting of:	
Lime	38.04
Magnesia	.60
Iron and alumina	2.92
Carbonic acid	26.37
Phosphoric acid	.23
Soda	1.56
Potassa	1.90
Water	1.00
	100.11

ANALYSIS OF WINE RECEIVED FROM ADMIRAL AMMEN.

Specific gravity, at 17.5° C., .98471.
Specific gravity, at 20° C., of distillate, .98095.

Percentage of alcohol, by weight			10.61
Percentage of water, by weight			87.00
Percentage of acetic acid			.29
Solid residue	cane sugar	.47	2.10
	grape sugar	.25	
	tartaric acid	.11	
	extractives	1.04	
	ash soluble in water .16; ash insoluble in water .07	.23	
			100.00

The amount of free acetic acid in this wine is too great to allow it to be classed as good. The greatest amount allowable in any wine is .20 per cent., while the amount present in high-grade wines seldom exceeds .10 to .12 per cent.

In other respects this wine is normal, and free from injurious substances; there is no evidence of sophistication of any sort. The alcoholic strength is low, as the best sherry and port can, and usually do, contain from 13 to 17 per cent of alcohol by weight.

ANALYSIS OF MATERIALS SENT BY J. W. SANBORN FROM HANOVER, N. H., APRIL 15, 1879.

Constituents.	Swale hay.	Ground meat.	Cotton seed meal.
Water, &c., at 105°	6.41	9.37	8.27
Organic matter	87.26	80.66	83.96
Ash	6.33	9.97	7.77
	100.00	100.00	100.00
Loss at 105° C	6.41	9.37	8.27
Ash	6.33	9.97	7.77
Nitrogen	1.13	8.48	7.42
Albuminoids	7.07	53.02	46.37
Sugars	9.12		
Gum, &c	2.67		
Oil, &c	3.63		
Amyl. cellulose	25.12		
Cellulose	21.39		
Alkaline extract	18.26		
	100.00		

PROXIMATE ANALYSES OF WHEATS.

Analyses have been made during the past year of the following kinds of wheat.

Winter wheats.

1. Mold's White, grown in England.
2. Mold's Red, grown in England.
3. Yellow Missouri.
4. Swamp, grown in Ohio.
5. Victor, grown in Ontario, Canada.
6. Silver Chaff, grown in Ontario, Canada.
7. Foizy, grown in Oregon.
8. Brazilian, grown in Oregon.
9. Polish, grown in Maryland.
10. White, grown in Oregon.

Spring wheats.

11. Improved Fife, grown in Ontario, Canada
12. Champlain, grown in New York.
13. Defiance, grown in New York.
14. Chili Club, grown in Oregon.
15. Noah Island, grown in Oregon.

ANALYSES OF RYE AND BARLEY.

Analyses have also been made of one specimen each of barley and rye.

16. Nepaul barley, grown in California.
17. White Winter rye, grown in Pennsylvania.

ANALYSES OF MAIZE.

There have been made also analyses of specimens of maize, as follows:

Sugar corn.

18. Stowell's Evergreen, grown in New England.
19. Egyptian, grown in Maryland.

20. Red River, grown in Minnesota.
21. Golden, grown in Massachusetts.
22. Marblehead Mammoth, grown in Massachusetts.
23. Prolific.
24. Proctor's, grown in Massachusetts.

White corn.

25. Improved Prolific, grown in Tennessee.
26. White Dent, grown in North Carolina.
27. White Mexican, grown in Mexico.
28. White Prolific, grown in Pennsylvania.
29. Mexican White Dent, grown in Mexico.
30. Oregon White, grown in Oregon.
31. Small Eight-rowed, grown in New Hampshire.

Yellow corn.

32. Compton's Early, grown in Pennsylvania.
33. Adams's, grown in New Hampshire.
34. Canada, grown in New Hampshire.
35. Vermont, grown in Vermont.
36. Small Twelve-rowed, grown in New Hampshire.
37. State Fair Premium, grown in New Hampshire.
38. Large Premium, grown in New Hampshire.
39. Board of Agriculture, grown in New Hampshire.

Other varieties.

40. King Philip, red, grown in New Hampshire.
41. Mexican, blue, grown in Mexico.
42. Miscegenation, white and blue, grown in New Hampshire.
43. Pitch Knot, grown in New Hampshire.
44. Tom Thumb Pop, yellow, grown in New Hampshire.
45. Pop Corn, white.

Analyses of the grain of winter wheats.

Constituents.	Mold's White.	Mold's Red.	Yellow Missouri.	Swamp.	Victor.	Silver Chaff.	Foizy.	Brazilian.	Polish.	**White.**
Water	8.64	8.75	7.69	7.63	7.49	8.93	8.98	9.29	10.08	**9.52**
Oils	2.32	2.05	2.11	2.41	2.27	2.44	2.28	1.99	2.67	**1.69**
Sugars	3.12	2.74	2.92	2.92	2.66	3.79	3.78	4.67	3.77	**4.21**
Albuminoids soluble in alcohol	1.07	1.51	2.06	1.08	3.52	2.70	3.38	3.23	3.08	**2.34**
Albuminoids insoluble in alcohol	8.56	8.99	9.53	10.51	5.93	7.10	5.02	6.22	9.35	**6.24**
Gum	3.38	2.58	2.02	3.26	1.88	2.54	3.77	2.51	1.93	**2.66**
Cellulose	1.63	1.27	1.53	1.54	1.69	1.75	1.25	1.17	1.56	**1.53**
Ash	1.64	1.72	1.91	1.84	1.39	1.58	1.57	1.77	1.67	**1.57**
Starch, by difference*	69.64	70.39	70.23	68.81	73.17	69.08	69.97	69.15	65.89	**70.24**
	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.00

*The starch in the samples of wheat Nos. 1, 2, 3, and 4 was also determined by way of control, by converting it into glucose and precipitating with Fehling's solution. The results obtained in this way were slightly higher than those above given by difference, viz: No. 1, 69.35 per cent.; No. 2, 71.76 per cent.; No. 3, 70.45 per cent.; No. 4, 70.44 per cent.—an average excess of .73 per cent., which doubtless arose from the small portion taken in each case for determination with the copper solution, and the multiplication of the unavoidable error in work.

Analyses of the grain of spring wheats, barley, aud rye.

Constituents.	Improved Fife wheat.	Champlain wheat.	Defiance wheat.	Chili Club wheat.	Noah Island wheat.	Nepaul barley.	White Winter rye.
Water	8. 50	8. 79	8. 12	7. 90	9. 64	7. 23	8. 68
Oils	2. 56	2. 55	2. 49	2. 33	2. 06	3. 15	2. 07
Sugars	3. 37	3. 61	3. 50	4. 07	3. 30	3. 17	4. 82
Albuminoids soluble in alcohol	4. 69	4. 45	4. 10	2. 73	2. 74	2. 10	2. 72
Albuminoids insoluble in alcohol	10. 01	10. 95	9. 90	5. 41	7. 06	11. 07	9. 35
Gum	2. 46	2. 12	2. 27	4. 45	2. 14	2. 97	4. 40
Cellulose	1. 62	1. 49	2. 04	1. 41	1. 92	1. 55	1. 40
Ash	1. 47	2. 05	1. 57	1. 56	2. 00	1. 94	1. 87
Starch, by difference	65. 32	63. 99	66. 01	70. 14	69. 14	66. 82	64. 69
	100.	100.	100.	100.	100.	100.	100. 00

Analyses of sugar corn.

Constituents.	Stowell's Evergreen.	Egyptian.	Red River.	Golden.	Marblehead Mammoth.	Prolific.	Proctor's.
Water	5. 98	7. 54	9. 13	6. 27	6. 47	10. 38	10. 13
Oils	8. 00	7. 80	9. 31	9. 17	9. 00	7. 65	7. 95
Sugars	4. 80	6. 34	5. 49	6. 22	5. 84	5. 77	6. 77
Albumin	6. 89	5. 79	5. 82	5. 84	6. 11	5. 35	5. 55
Zein	5. 02	5. 76	5. 91	8. 51	6. 67	4. 98	6. 53
Soluble starch and gum	18. 65	22. 50	20. 69	14. 50	22. 65	19. 50	17. 76
Cellulose	2. 66	2. 02	1. 46	1. 58	1. 88	2. 04	1. 75
Ash	1. 92	1. 92	1. 89	1. 93	1. 92	1. 87	1. 92
Starch, by difference	46. 08	40. 33	40. 30	45. 98	39. 46	42. 46	41. 64
	100.	100.	100.	100.	100.	100.	100. 00

Analyses of white corn.

Constituents.	Improved Prolific.	White Dent.	White Mexican.	White Prolific	Mexican White Dent.	Oregon White.	Small Eight-rowed.
Water	7. 58	6. 74	8. 65	8. 96	11. 14	9. 25	11. 05
Oils	5. 09	5. 18	4. 90	5. 82	6. 28	7. 08	4. 60
Sugars	1. 98	2. 75	2. 13	1. 95	2. 00	2. 47	1. 94
Albumin, insoluble in alcohol	5. 64	6. 20	4. 84	3. 88	5. 70	2. 91	5. 79
Zein, soluble in alcohol	3. 65	4. 83	5. 31	4. 17	4. 97	4. 97	7. 86
Gum	2. 70	1. 75	1. 83	1. 73	2. 80	2. 55	2. 74
Cellulose	2. 65	1. 53	1. 64	1. 25	1. 59	1. 26	1. 30
Ash	1. 23	1. 43	1. 87	1. 43	1. 45	1. 46	1. 57
Starch, by difference	69. 48	69. 59	68. 83	70. 81	64. 07	68. 05	62. 95
	100.	100.	100.	100.	100.	100.	100. 00

Analyses of yellow corn.

Constituents.	Compton's Early.	Adams's.	Canada.	Vermont.	Small Twelve-rowed.	State Fair Premium.	Large Premium.	Board of Agriculture.
Water	6.59	8.61	8.27	8.64	11.48	10.19	10.00	11.09
Oils	5.30	4.83	5.60	5.63	6.03	5.29	5.52	4.68
Sugar	2.06	2.25	2.52	1.47	2.64	2.87	2.35	1.69
Albumin	5.42	4.01	5.16	3.89	4.84	5.56	5.25	4.67
Zein	4.48	6.49	6.20	6.25	5.66	5.26	6.11	6.88
Gum	2.77	1.50	1.68	2.15	1.80	1.37	1.80	2.14
Cellulose	2.09	1.19	1.26	1.38	1.09	1.06	1.09	.82
Ash	1.64	1.57	1.72	1.45	1.34	1.78	1.46	1.31
Starch, by difference	69.65	69.55	67.59	69.14	65.72	66.62	66.42	66.72
	100.	100.	100.	100.	100.	100.	100.	100.00

Different varieties of corn.

Constituents.	King Philip.	Mexican, blue.	Miscegenation.	Pitch-Knot.	Tom Thumb, yellow.	Pop-corn, white.
Water	10.23	8.97	9.92	11.24	9.05	8.61
Oils	7.05	5.25	5.33	5.26	5.89	5.63
Sugars	2.35	1.72	1.95	2.72	2.22	2.58
Albumin, insoluble in alcohol	4.31	3.88	5.26	5.39	4.80	6.77
Zein, soluble in alcohol	7.77	6.33	6.46	5.81	7.80	6.36
Gum	3.18	2.05	2.16	2.20	3.00	2.16
Cellulose	1.01	1.80	1.05	1.04	1.33	2.32
Ash	1.84	1.42	1.63	1.52	1.60	1.63
Starch, by difference	62.26	68.58	66.24	64.82	64.31	63.94
	100.	100.	100.	100.	100.	100.00

For convenience of comparison the foregoing analyses have been calculated to the water-free substance, and the analyses thus corrected are as follows:

Winter wheats.

Constituents.	Mold's White.	Mold's Red.	Yellow Missouri.	Swamp.	Victor.	Silver Chaff.	Foxy.	Brazilian.	Polish.	White.
Oils	2.54	2.25	2.29	2.61	2.44	2.68	2.51	2.19	2.97	1.87
Sugars	3.41	3.00	3.16	3.16	2.88	4.17	4.15	5.15	4.19	4.65
Albuminoids, soluble in alcohol	1.17	1.65	2.23	1.17	3.81	2.97	3.71	3.56	3.42	2.58
Albuminoids, insoluble in alcohol	9.37	9.85	10.33	11.38	6.41	7.89	5.52	6.86	10.40	6.89
Gum	3.70	2.83	2.19	3.53	2.03	2.79	4.14	2.77	2.14	2.94
Cellulose	1.78	1.39	1.66	1.67	1.83	1.92	1.37	1.29	1.73	1.68
Ash	1.79	1.88	2.07	2.00	1.50	1.73	1.73	1.95	1.86	1.74
Starch	76.24	77.15	76.07	74.48	79.10	75.85	76.87	76.23	73.29	77.65
	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.00

Spring wheats, barley, and rye.

Constituents.	Improved Fife.	Champlain.	Defiance.	Chili Club.	Noah Island.	Nepaul barley.	White Winter rye.
Oils	2.80	2.80	2.71	2.53	2.28	3.40	2.26
Sugars	3.68	3.96	3.81	4.42	3.67	3.42	5.27
Albuminoids soluble in alcohol	5.13	4.88	4.46	2.96	3.03	2.26	2.97
Albuminoids insoluble in alcohol	10.94	12.01	10.77	5.87	7.81	11.93	10.24
Gum	2.69	2.32	2.47	4.83	2.37	3.20	4.80
Cellulose	1.77	1.63	2.22	1.53	2.12	1.67	1.54
Ash	1.61	2.25	1.71	1.69	2.21	2.09	2.04
Starch	71.38	70.15	71.85	76.17	76.51	72.03	70.88
	100.	100.	100.	100.	100.	100.	100.00

Sugar corn.

Constituents.	Stowell's Evergreen.	Egyptian.	Red River.	Golden.	Marblehead Mammoth.	Prolific.	Proctor's.
Oils	8.51	8.53	10.24	9.78	9.62	8.50	8.84
Sugars	5.11	6.85	6.04	6.64	6.25	6.42	7.53
Albuminoids soluble in alcohol or zein	7.33	6.25	6.41	6.23	6.54	5.95	6.17
Albuminoids insoluble in alcohol	5.34	6.23	6.51	9.08	7.13	5.54	7.27
Gum and soluble starch	19.84	24.30	22.77	15.47	24.22	33.05	31.72
Cellulose	2.83	2.19	1.60	1.69	2.01	2.26	1.95
Ash	2.04	2.07	2.07	2.06	2.06	2.07	2.14
Starch	49.00	43.58	44.36	49.05	42.17	36.21	34.38
	100.	100.	100.	100.	100.	100.	100.00

White corn.

Constituents.	Improved Prolific.	White Dent.	White Mexican.	White Prolific.	Mexican White Dent.	Oregon White.	Small Eight-rowed.
Oils	5.51	5.56	5.36	6.40	7.07	7.80	5.40
Sugar	2.14	2.95	2.33	2.14	2.25	2.72	2.18
Albumin insoluble in alcohol	6.10	6.64	5.30	4.26	6.42	3.21	6.51
Zein soluble in alcohol	3.95	5.18	5.81	4.58	5.60	5.47	8.84
Gum	2.92	1.88	2.00	1.90	3.14	2.80	3.08
Cellulose	2.87	1.64	1.79	1.37	1.79	1.39	1.46
Ash	1.33	1.54	2.04	1.57	1.63	1.61	1.76
Starch	75.18	74.61	75.37	77.78	72.10	75.00	70.77
	100.	100.	100.	100.	100.	100.	100.00

Yellow corn.

Constituents.	Compton's Early.	Adams's.	Canada.	Vermont.	Small Twelve-rowed.	State Fair Premium.	Large Premium.	Board of Agriculture.
Oils	5.67	5.28	6.11	6.17	6.81	5.89	6.14	5.26
Sugars	2.20	2.46	2.74	1.61	2.31	3.19	2.61	1.90
Albumin insoluble in alcohol	5.80	4.38	5.60	4.26	5.47	6.19	5.84	5.25
Zein soluble in alcohol	4.79	7.10	6.76	6.84	6.40	5.86	6.79	7.74
Gum	2.96	1.64	1.83	2.35	2.03	1.52	2.00	2.40
Cellulose	2.24	1.30	1.37	1.51	1.23	1.18	1.21	.90
Ash	1.76	1.72	1.87	1.59	1.51	1.98	1.62	1.47
Starch	74.58	76.12	73.72	75.67	74.24	74.19	73.79	75.08
	100.	100.	100.	100.	100.	100.	100.	100.00

Different varieties of corn.

Constituents.	King Philip.	Mexican, blue.	Miscegenation.	Pitch-Knot.	Tom Thumb, yellow.	Pop-corn, white.
Oils	7.86	5.77	5.92	5.92	6.47	6.16
Sugars	2.61	1.89	2.17	3.02	2.44	2.82
Albumin insoluble in alcohol	4.81	4.26	5.84	6.07	5.28	7.41
Zein soluble in alcohol	8.66	6.96	7.17	6.55	8.57	6.96
Gum	3.55	2.25	2.40	2.49	3.30	2.36
Cellulose	1.13	1.98	1.17	1.17	1.46	2.54
Ash	2.04	1.56	1.81	1.71	1.76	1.78
Starch	69.34	75.33	73.52	73.07	70.72	69.97
	100.	100.	100.	100.	100.	100.00

In the following summary, for still more convenience in comparison, the averages are given of the several analyses already given of winter wheats, spring wheats, sugar corn, yellow corn, white corn, and mixed corns, both with and without water:

Constituents.	Average of 10 winter wheats.	Average of 5 spring wheats.	Average of 7 sugar corns.	Average of 8 yellow corns.	Average of 7 white corns.	Average of 6 other varieties of corn.
Water	8.70	8.59	7.99	9.36	9.05	9.67
Oils	2.22	2.40	8.41	5.36	5.59	5.74
Sugar	3.46	3.57	5.89	2.16	2.17	2.26
Albumin insoluble	7.75	8.67	5.91	4.85	4.99	5.07
Albumen soluble, or zein	2.40	3.74	6.20	5.92	5.11	6.75
Soluble starch and gum	2.65	2.69	22.52	1.90	2.30	2.46
Cellulose	1.49	1.70	1.91	1.25	1.60	1.42
Ash	1.67	1.73	1.91	1.53	1.49	1.61
Starch	69.66	66.91	39.26	67.67	67.70	65.02
	100.	100.	100.	100.	100.	100.
Oils	2.43	2.62	9.14	5.91	6.14	6.35
Sugar	3.79	3.91	6.40	2.38	2.38	2.50
Albuminoids soluble in alcohol	8.49	9.49	6.42	5.35	5.48	5.61
Albuminoids insoluble, or zein	2.63	4.09	6.74	6.53	5.62	7.47
Soluble starch and gum	2.90	2.94	24.48	2.09	2.53	2.72
Cellulose	1.63	1.86	2.08	1.38	1.76	1.57
Ash	1.83	1.89	2.08	1.69	1.64	1.78
Starch	76.30	73.20	42.66	74.67	74.45	72.00
	100.	100.	100.	100.	100.	100.00

METHODS OF ANALYSIS.

It has seemed best to give with some detail the several methods of analysis employed in the foregoing work, in order that they may be subjected to criticism in so far as may be thought best, and adopted by others if upon a careful examination they shall appear worthy; but especially that the results reported may be hereafter subjected to revision when better methods may be devised than those employed in this work. Each for himself may determine how far the methods of separation have been successful. What is claimed is, that the work has been faithfully performed according to the described processes, and, in so far as was possible by such processes, the results may be relied upon by those having occasion to make use of these published results.

There yet remain many points which require to be carefully investigated, as will appear from what has been given, and any suggestions from those engaged in similar investigations will be very gratefully acknowledged. It is very much to be desired that something approaching uniformity in methods of proximate analysis be adopted, so that each may have the benefit of the work performed by all, and something like uniformity may exist in the methods and results of our several agricultural laboratories.

Method for analysis of grain.

1. PREPARATION OF SAMPLE.—The grain is carefully examined, kernel by kernel, and all unsound grains and extraneous matters rejected. It is then pulverized in an iron mortar, care being taken that none be lost. Finally it is all sifted through a sieve of eighty meshes to the linear inch. The powder so obtained is thoroughly separated from any iron derived from the mortar, by means of a magnet. It is then placed in wide-mouth cork-stoppered bottles.

2. ESTIMATION OF MOISTURE.—About two grams of the finely powdered grain is dried in an air-bath, at a temperature of 110–115° C. The drying requires from one to two days' time; it is best to do it as rapidly as possible. The loss of weight is moisture.

3. ESTIMATION OF ASH.—About two grams of the powdered grain (the residue after determination of moisture, usually) is ignited, at a red heat, over a Bunsen burner until nearly or quite free from carbonaceous matter. The amount of ash thus obtained is a little greater than is found by the estimation of the several inorganic constituents; this excess is carbon and a little carbonic acid, and seldom exceeds .3 to .4 per cent.

4. ESTIMATION OF CELLULOSE.—Four grams of the powdered grain is boiled with 200 c. c. of 5 per cent. sulphuric acid, until the starch is all converted to glucose. This usually requires from six to eight hours.

The separated cellulose and albuminoids are removed by use of a Bunsen filter-pump and a fine linen filter, washed with water and transferred to the same beaker, when they are again boiled tor two hours with 150 c. c. of 2 per cent. sodic hydrate solution.

The liquid is filtered again through the same linen, and the cellulose upon the filter is well washed with hot water, alcohol of about 90 per cent., and ether. The cellulose is then transferred, by means of a platinum spatula and camel's hair brush, to a crucible, dried at 120° to 130° C., weighed, ignited, and again weighed. The difference between these two weights equals, approximately, the amount of cellulose. The accurate estimation of cellulose is yet very difficult, if not impossible, yet it is probable that results obtained as above stated are not far from the truth.

5. ESTIMATION OF OIL.—Exactly two grams of the powdered grain are extracted by repercolation with Squibb's stronger ether. The time required for complete extraction is not over three hours, and probably less would be as well. The ether is carefully evaporated and the oil dried at 100° C. until two weighings do not vary more than .001 gram.

6. ESTIMATION OF SUGARS AND OF ALBUMINOIDS SOLUBLE IN ALCOHOL OF 80 PER CENT.—The grain remaining after the removal of oil is dried, and is then treated by repercolation for twelve to fifteen hours with warm alcohol of 80 per cent., by weight.

The alcoholic solution is evaporated, dried, and weighed. This residue = sugar, albuminoids, and ash. It is then treated for several hours with cold water, which removes all the sugar, and in case of wheat a very slight amount of albuminoids. This liquid is evaporated, dried at 110° C., weighed, ignited, and again weighed. The difference between the first and second weighings represents the sugar in two grams of the grain.

The residue insoluble in water is stated as albuminoid matter insoluble in water, soluble in alcohol. In wheat this albuminoid matter consists of gluten and casein; in corn it has been stated as zein, although some investigators give it the name gluten-casein, and suppose it to be identical with the albuminoid matters similarly extracted from wheat.

The sugar of wheat and corn seems to differ materially both from cane sugar and inverted sugar. On several occasions it separated in groups of prisms upon slow evaporation of its solution in 80 per cent. alcohol. Its taste is not particularly sweet, nor does it reduce Fehling's solution, except slightly, until it has been inverted by dilute acids.

ESTIMATION OF GUM.—The residual grain, after treatment with 80 per cent. alcohol, is dried and then removed to a graduated cylinder, to which is added 200 c. c. of cold water. The mixture is frequently agitated during about four hours. One hundred c. c. are filtered by aid of the Bunsen pump, evaporated and weighed, ignited, and again weighed. The difference between these two weights equals the gum in one gram, ash-free.

This gum extract in wheat usually contains a trace only of albuminoid matter, not sufficient to greatly vitiate the results. In ordinary maize the gum extract seems to be free from albuminoid substances. In sweet corn the extract here obtained is turbid and cannot be made clearer by repeated filtrations through fine paper.

This turbid liquid gives the characteristic blue color of starch with solution of iodine. This color is permanent, if sufficient iodine has been used, and the blue starch iodide does not fall to the bottom, as is usual with ordinary starch. When the turbid aqueous liquid is evaporated a very large white residue remains; it differs very plainly from the gum residues obtained from ordinary maize, for they are very slight, and varnish-like in appearance.

Millon's reagent gives a somewhat questionable indication for albuminoid matter. It seems, then, that sugar corn contains considerable starch in a modified soluble condition, and that the invariable turbidity of aqueous extracts of sugar corn is due to this soluble modification of starch rather than to the "presence of a trace of suspended fat (?)," as suggested by W. O. Atwater. (Am. J. Sci. and Arts, vol. 48, 1869, p. 357.) The amount of this modified starch and gum was estimated by subtracting from the water extract, in a sample of the whole grain, the sum of the sugar and albuminoids soluble in water. In this case all the albuminoids not removed by alcohol were considered soluble in water, although there is some doubt upon this point, which, it is hoped,

will be settled positively before another year. In case a part only of the albuminoid matter was soluble in water, the amount of soluble starch and gum would be correspondingly increased and the insoluble starch equally diminished. A determination of the albuminoids soluble in water in "Prolific" sugar corn revealed the presence of 1.92 per cent. From the unsatisfactory reactions obtained with Millon's reagent it seems probable that the amounts of albuminoid matters soluble in water are not much greater in any of the samples examined. Further investigations will be made in this direction.

Two experiments were made with the sample of sweet corn No. 24, as follows:

Five grams of the finely powdered grain were shaken up with 500 c. c. of water, and allowed to stand for four hours, with occasional shaking; the liquid was then filtered off, the filtrate being turbid as usual, and an aliquot portion tested for glucose (?) with Fehling's solution, both before and after inversion with dilute sulphuric acid. A larger portion of the filtrate was evaporated to dryness, and the nitrogen determined in the dry residue left upon evaporation. The following results were obtained in duplicate:

	Per cent.	Per cent.
Soluble in water	43.78	43.37
Albuminoids soluble in water	1.92	2.03
Glucose (?) before inverting	7.92	8.58
Glucose after inverting 1 hour	29.95	26.95
Glucose after inverting 2 hours	36.00	33.16

The above results are calculated to the air-dry grain analyzed, which contained 10.13 per cent. of water.

The amounts of starch inverted in the above experiments were as follows:

	Per cent.	Per cent.
Starch inverted after 1 hour	19.83	15.90
Starch inverted after 2 hours	25.27	22.22

It will appear, therefore, that only a portion of the albumen insoluble in alcohol was soluble in water, and that the analysis of this sample of sweet corn should have 3.57 per cent. added to the soluble starch and gum and an equal amount subtracted from the starch. The corrected analysis for the air-dry and water-free grain would then be as follows:

Sugar corn No. 24.

Constituents.	Air-dry.	Water-free.
	Per ct.	*Per ct.*
Water	10.13	......
Ash	1.92	2.14
Oils	7.95	8.85
Sugar	6.77	7.53
Zein	6.53	7.27
Albumin insoluble in alcohol and water	3.57	3.98
Albumin insoluble in alcohol and soluble in water	1.98	2.20
Soluble starch and gum	21.33	23.73
Cellulose	1.75	1.94
Starch, by difference	38.07	42.36
	100.00	100.00

Without doubt a similar correction is necessary in the case of the other sweet corns analyzed, the soluble starch being too low and the

common starch too high, through having calculated all of the albuminoids except zein as being soluble in water.

A very noticeable fact is that the microscope shows the starch granules of sweet corn to be very much larger (.001 inch diameter) than those in ordinary corn (in White Dent .00025 to .0003 inch diameter, T. Taylor). If a whole grain of sweet corn be soaked in water containing a little acetic acid there will be extracted the same soluble starch which was obtained in analysis of the powdered grain. This starch shows no organized granular structure when seen under the microscope, and when treated with iodine the liquid appears equally colored throughout.

From this it appears that there exists in sweet corn a considerable amount of strach in an amorphous and soluble condition. That this amount may be slightly increased by the process of pulverization in an iron mortar is possible, for it has been shown by Redwood that large starch-grains may be ruptured by trituration, while smaller grains escape.

The considerable variations in the amounts of soluble starch and gum in the different samples of sweet corn may be due to various causes.

First. Different amounts actually present.

Secondly. A greater number of starch-grains may be ruptured in pulverizing different samples.

Thirdly. It seems probable that partial fermentation of the air-dry sample may render part of the starch soluble.

It is well known that ordinary cornmeal undergoes some such changes when kept for some time, and it would seem that the meal from sweet corn, containing, as it does, much more sugar, would be still more likely to ferment.

It is almost impossible to get identical amounts of water extract from the same sample of sweet corn, even when duplicate determinations are made at the same time and under the same conditions. It appears, then, that the figures for soluble starch are valuable chiefly as preliminary statements. Work already commenced will, it is hoped, give more definite results and better methods of estimation.

ESTIMATION OF TOTAL ALBUMINOIDS.—The grass is burned with excess of soda-lime, and the evolved ammonia received in decinormal acid. The total nitrogen multiplied by 6.25 equals the total albumnioids.

Sweet corn differs from ordinary field corn in several particulars:

1. In its greater content of sugars; in the samples analyzed the proportion is 2.65 to 1.

2. In sweet corn the amounts of sugar and zein are about equal; in field corn the proportion of zein to sugar is 2.7 to 1.

3. Only 5 to 5.5 per cent. of field corn is dissolved by cold water; the solution so formed may be filtered perfectly clear, and contains no starch, but only sugars and gum. If sweet corn be treated in the same way with cold water a milky liquid results which cannot be filtered clear by use of double papers. The amounts thus dissolved average about 32 per cent. of the air-dry grain. The filtered solutions thus obtained contain some amylaceous matter, which gives with iodine a light violet color; when only a slight amount of iodine is added the color fades, but may be renewed by further additions of iodine. This amylaceous matter is probably similar to the "amiduline" and "amylogen" of older German chemists. It will be understood that the term "soluble starch" is used in these analyses to indicate this soluble matter which is colored blue-violet by iodine. In this connection it seems probable that the analysis of "Stowell's Evergreen sweet corn," made by W. O. Atwater,* is, in part,

*American Journal Science and Arts, 1869, vol. 48, p. 352.

incorrect in the amount of sugar (11.64 per cent.), in the amount soluble in cold water (16.28 per cent.), and in the entire omission of this amylaceous matter.

It will be seen again that one effect of crossing has been to make the amount of soluble starch in Golden sugar corn considerably less than in the ordinary varieties of sweet corn.

4. The much greater amount of oil in sweet corn is noticeable.

Chemical analysis seems to give no clew as to the reason why popcorn should "pop" when heated. The amount of albuminoid matter is higher and starch is lower than in other kinds of corn; in other respects the difference is not strongly marked.

A noticeable difference between winter and spring wheats is seen in the greater content of albuminoid matter in spring wheat; the starch is in equal measure diminished, while all the other constituents are practically the same.

It would be obviously premature to enter into very extensive generalizations based upon the results of comparatively a few analyses, but it is contemplated to continue these analyses of our cereals and grasses; and that those desiring to use the data furnished by the analyses given may rely upon the results with confidence, in so far as the methods made use of in analysis were reliable, it may be added that in every case where reasonable doubt existed as to the accuracy of any determination through any excess or deficiency of any constituent comparatively, such determination has been made in duplicate or triplicate when thought advisable. In other cases where a normal amount of any constituent was found present a single determination has sufficed generally.

It is greatly to be desired that before long more liberal provision may be made, both in laboratory facilities and working force, for the vast amount of chemical work pressing upon this division, which, as the report will show, has been requested to carry through chemical investigations for nearly every department of the government, and which requires for even the work exclusively its own, fully ten times the force at present assigned it by law.

Respectfully submitted.

PETER COLLIER,
Chemist.

To Hon. WILLIAM G. LEDUC,
Commissioner of Agriculture.

REPORT OF THE BOTANIST AND CHEMIST ON GRASSES AND FORAGE PLANTS.

The importance of the grasses in all systems of agriculture can hardly be overestimated. Indeed, the proportion of meadow and pasture lands in any region is a good criterion of the agricultural wealth of that region.

In some portions of our country the importance of the grass crops has been overlooked in the desire to realize immediate results from special crops. The result has generally been impoverished land and too frequently an impoverished people. The farmer who has an abundance of pasturage and meadow land has the elements of wealth in his hands. Cattle and stock can be raised on the grass, and they return to the land those fertilizing materials which, judiciously employed, keep the land always in good condition and give sure and reliable returns.

Intelligent and enterprising agriculturists in all parts of the country are now awake to the importance of this subject, and are anxiously inquiring into the value and adaptation of different kinds of grasses for their use.

The difference of soil and climate in different portions of our extensive country are such as to require the cultivation of a large variety of grasses. In some sections the rigor of climate is such that it is necessary to stable and feed cattle for six months of the year. In other sections, and particularly in the Gulf States, stock can obtain their living in the field not only in summer, but during the winter season also, provided they have access to grasses which make their growth at that season. There is a class of grasses which in the Southern and Southwestern States seem adapted to this purpose, and which are commonly known as winter grasses. These are mostly grasses of a rather coarse structure, and are chiefly valuable before they send up their flowering stalks, which are usually harsh and innutritious. Mr. C. W. Howard, in his treatise "On the Cultivation of the Grasses and Forage Plants at the South," says:

> One of the most marked and singular advantages of the South is its ability to grow grasses which may be pastured in the winter. It is a blessing of climate which we have not yet appreciated. * * * By the aid of the winter grasses it is perfectly practicable to raise colts, cattle, and sheep throughout a large portion of the South without other cost than the interest on land and the value of the salt. * * * There is no adequate substitute for winter-grass pastures. Oats, barley, and rye may be grazed, but the stock must be taken from them at a season when the necessity is most pinching, and, besides, they must be sowed annually, which is expensive. * * * In this connectien it will not be amiss to make some remarks on winter pastures generally. They must not be pastured when the ground is wet; at such times all stock must be removed from them. They must not at any time be grazed too closely. Everybody knows how to treat a rye or barley lot. It is well known that if stock bite into the crown of the plant it will be killed. Winter-grass pastures must be treated in the same way as grain pasture. The temptation to transgress in this particular is very great. When all other vegetable matter is dead, live stock become almost crazy for green food, and they are suffered by the sympathizing owner to remain while a particle of green food is visible. As a consequence of this practice persisted in, the grass is killed. It will be better to buy fodder if it be necessary, rather than allow a practice so ruinous to the farmer.

Another class of grasses are those which begin to grow late in the season and flourish through the dry and hot summer and autumn. Some of these grasses furnish an abundant yield, which may be cut several times during the season.

In order to test the value of the principal grasses and forage plants

which have been more or less employed in the South, this department solicited from Southern and Western agriculturists, the past season, samples of such grasses in sufficient quantities for analysis by the chemist of the department. The principal contributors, and their contributions, in response to this request, were as follows:

1st. From Prof. S. B. Buckley. Austin, Tex., the following kinds:

Panicum Texanum, Texas millet.
Panicum obtusum.
Panicum virgatum, Tall Panic, or Switch grass.
Panicum crusgalli, Barnyard grass, Cock's-foot.
Paspalum læve, Water grass.
Setaria setosa, Bristle grass.
Andropogon Virginicus, Broom Sedge, Sedge grass.
Sorghum nutans var., Wood grass.
Leptochloa mucronata, Feather grass.
Eleusine Indica, Yard grass, Crow-foot.
Tricuspis sesleroides.
Muhlenbergia diffusa, Drop-seed grass.

2d. From Mr. Charles Mohr, Mobile, Ala.:

Lespedeza striata, Japan clover.
Eleusine Indica, Yard grass.
Muhlenbergia diffusa, Drop seed.
Leptochloa mucronata, Feather grass.
Panicum sanguinale, Crab grass.
Panicum virgatum, Tall panic, Switch grass.
Panicum filiforme, Slender Crab grass.
Panicum anceps.
Panicum crus-galli, Barnyard grass, Cock's-foot.
Panicum proliferum, Crab grass, Sprouting Panic grass.
Panicum divaricatum, Cane-like Panic grass.
Paspalum præcox and other species.
Cynodon Dactylon, Bermuda grass, Wire grass.
Andropogon (3 species), Broom grass, Broom Sedge.
Sorghum Halapense, Johnson grass.
Uniola gracilis.

3d. From D. L. Phares, Woodville, Miss.:

Eleusine Indica Yard grass, Crow-foot grass.
Paspalum præcox, Water grass.
Leptochloa mucronata, Feather grass.
Panicum sanguinale, Crab grass.
Hordeum pratense, Barley grass.
Sporobolus Indicus, Smut grass.
Tripsacum dactyloides, Gama grass.
Panicum crusgalli, Barnyard grass.
Cynodon Dactylon, Bermuda grass.
Andropogon Virginicus, Broom grass, Broom Sedge.
Eragrostis poœoides, var.

4th. From Mr. W. A. Carswell, Americus, Ga.:

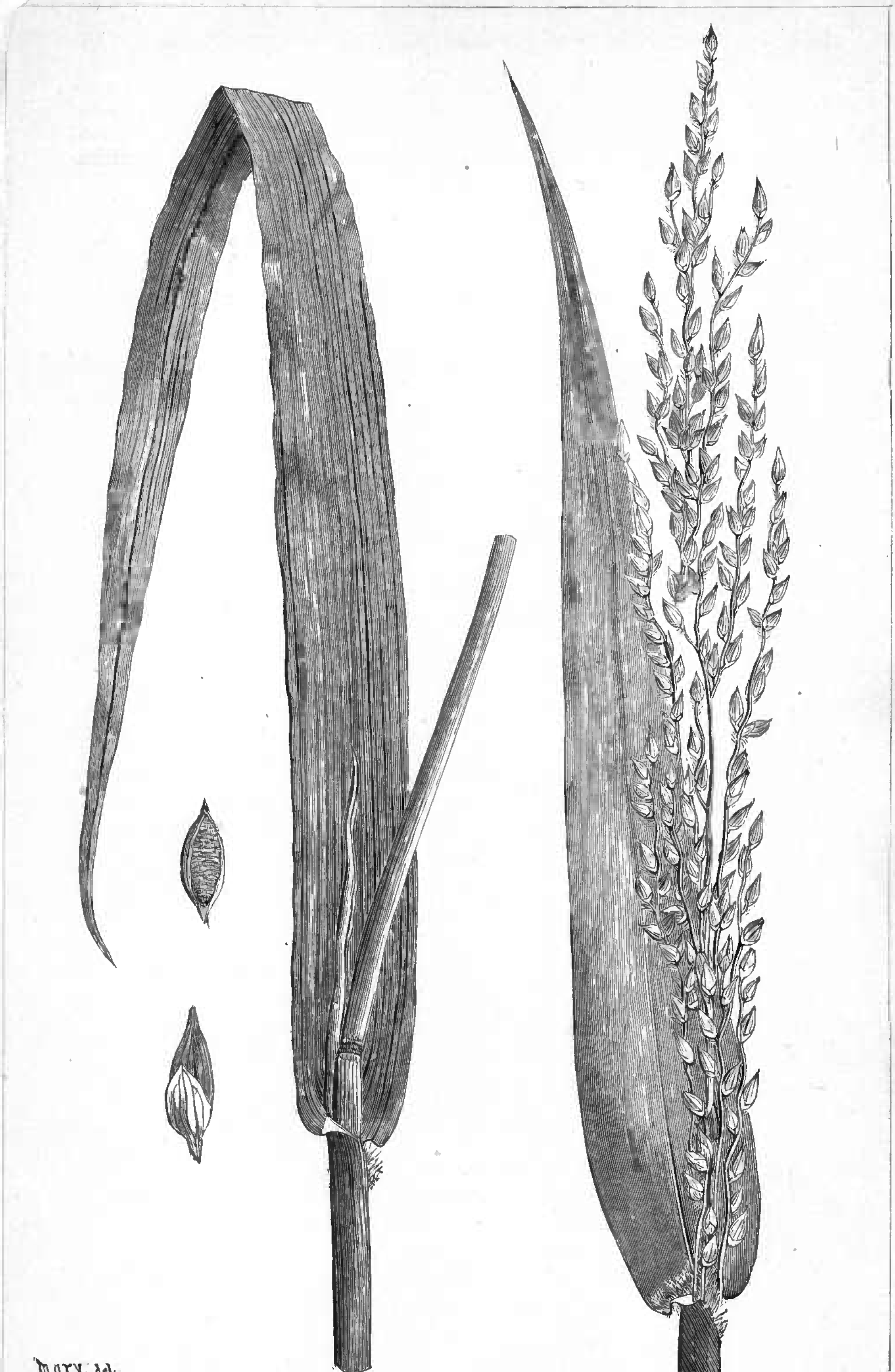
Eleusine Indica, Yard grass, Crow-foot grass.
Dactyloctenium Ægyptiacum Crow-foot grass.

5th. From Mr. E. Hall, Athens, Ill.:

Hierochloa borealis, Vanilla grass.
Bromus carinatus, California Brome grass.

6th. From Mr. Theo. Louis, Louisville, Wis.:

Poa pratensis, June grass, Blue grass.
Poa serotina, Fowl Meadow grass.
Agrostis exarata, Native red-top.



PANICUM TEXANUM.

Specimens were received from a number of other persons in quantities too small for chemical analysis, but in nearly all cases they were but repetitions of those above named. Some of the specimens analyzed are of very inferior quality, and not to be recommended for cultivation; but a great point is gained in the determination of that fact, and the description and figures given will enable every farmer to know which to adopt and which to reject.

In addition to the true grasses there is a line of forage plants belonging to other families which are found to have highly nutritive properties and to be well adopted to cultivation for various purposes. These are mainly leguminous plants, as the clovers (alfalfa or lucern) pease, and vetches. Some new plants of this class have recently attracted attention in the South, and are treated of in this paper. They are *Lespedeza striata* (Japan clover), *Richardsonia scabra* (Mexican clover), and a species of *Desmodium*, called in Florida beggar-lice.

The drawings of the grasses were carefully made by Mr. G. Marx, and the plates will be of great assistance in enabling farmers and others to identify the various kinds or species.

In the following pages the botanical name of the grass is first given, and then the common one or ones. A glossary of terms is given at the end, to which reference can be made when necessary.

The grasses belonging to the genus *Panicum*, sometimes called Panic grasses, are very numerous, and differ very widely in their appearance. The general botanical characters of the genus are as follows:

PANICUM.

Flowers in spikes, racemes, or panicles. Spikelets 2-flowered, or with one perfect and one rudimentary flower; glumes two, herbaceous, the lower one usually short or minute, the upper as long as the fertile flower; the lower flower either neutral or staminate, of one palet which closely resembles the upper glume, and sometimes with a second thin palet; the upper flower perfect, closed, coriaceous or cartilaginous, usually flattish parallel with the glumes, awnless, inclosing the free and grooveless grain; stamens three; stigmas plumose, usually purple.

PANICUM TEXANUM—Texas Millet.

Description.—Branches of the panicle rough, the pedicels with scattered hairs, especially near the flowers; spikelets oblong, somewhat pointed, 2 to 2½ lines long, sparsely hairy; lower glume half or two-thirds the length of the upper, acute, 5-nerved, the lateral nerves uniting with the midnerve below the apex; upper glume prominently 5 to 7 nerved, pointed; sterile flower with 2 palets, the lower 5 to 7 nerved, much like the upper glume, the upper palet thin and transparent, as long as the lower; perfect flower ovate or oblong-ovate, acutish, transversely wrinkled with fine reticulated striæ.

An annual grass two to four feet high, sparingly branched, at first erect, becoming decumbent and widely spreading, very leafy, sheaths and leaves finely soft—hairy; margin of the leaves rough; leaf blades 6 to 8 inches long and ½ to 1 inch wide, upper leaves reaching to the base of the panicle, or nearly so; panicle 6 to 8 inches long, strict, the branches alternate, erect, simple, 3 to 4 inches long, with somewhat scattered sessile spikelets.

Habit and uses.—A grass of vigorous, rapid growth. It is very leafy, the leaves broad, rather thin, sprinkled with short soft hairs. It grows 2 to 3 feet high, but the spreading stalks are often 4 feet or more in length, growing very close and thick at the base, and yielding a large amount of food.

This grass has been brought to the attention of the department during several years past. Mr. Pryor Lea, of Goliad, Texas, has had it in cultivation for a number of years, and writes respecting it as follows:

I consider it far superior to any grass that I ever saw for hay. It is a much more certain crop than millet, and cultivated with less labor, and all kinds of stock prefer it. I expect to report a good second crop on the same ground this year. In this region this grass, in the condition of well-cultured hay, is regarded as more nutritious than any other grass. It grows only in cultivated land; it prospers best in the warmest fourth of the year; its luxurious growth subdues other grasses and some weeds, with the result of leaving the ground in an ameliorated condition. (See Plate 1.)

Proximate analysis of Panicum Texanum, from Texas (Texas Millet).

	Per cent.
Oil	1.98
Wax	.56
Sugars	12.49
Gum and dextrin	5.98
Cellulose	27.68
Amylaceous cellulose	20.64
Alkali extract	18.43
Albuminoids	5.61
Ash	6.63
	100.00

Analysis of ash of Panicum Texanum (Texas Millet).

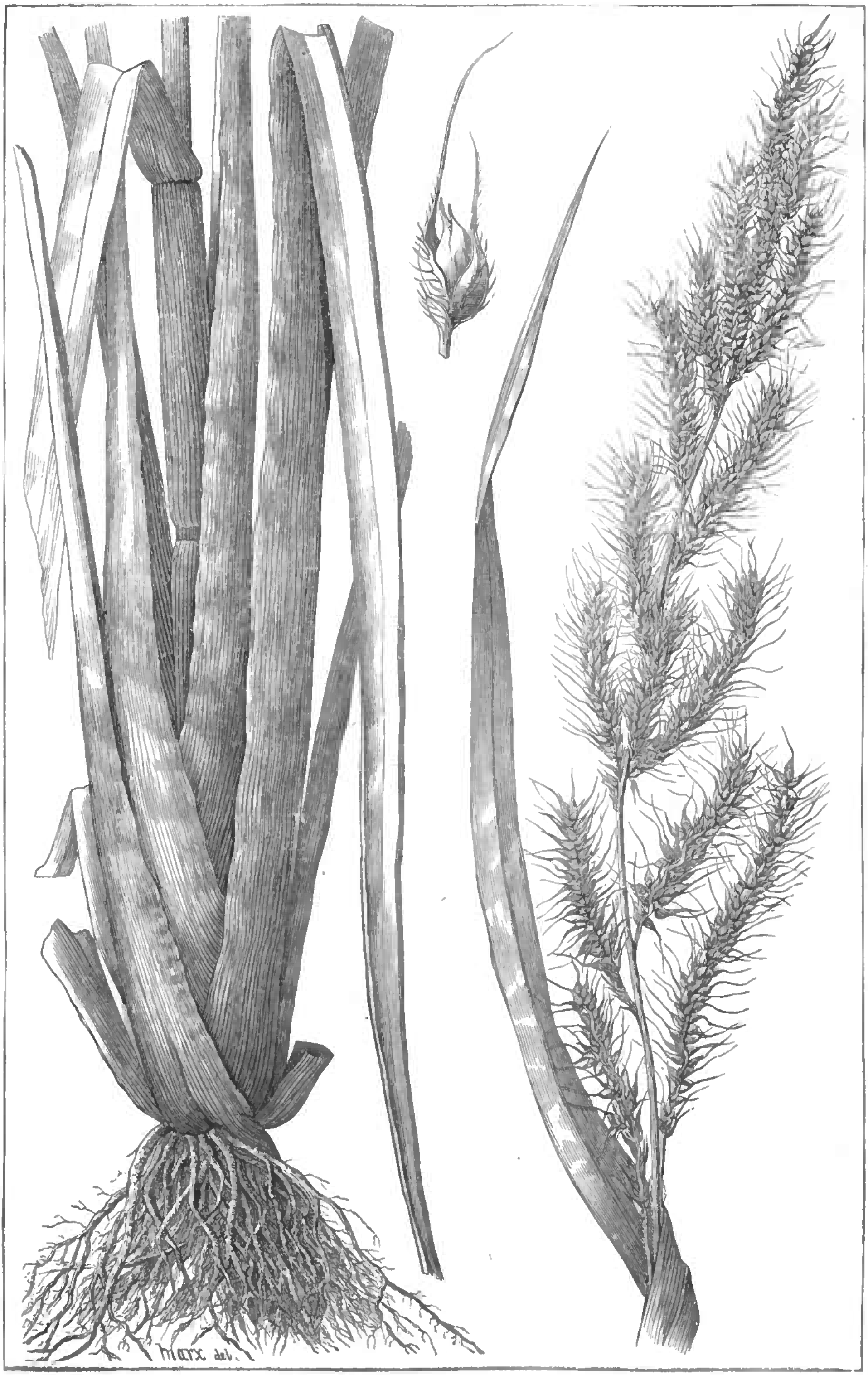
	Per cent.
Potassium	4.54
Potassium oxide	27.95
Sodium	1.58
Sodium oxide	....
Calcium oxide	7.39
Magnesium oxide	4.57
Sulphuric acid	4.63
Phosphoric acid	8.48
Silicic acid	34.31
Chlorine	6.55
	100.00

PANICUM CRUSGALLI—Barnyard grass, Cock's-foot grass.

Description.—This is an annual grass, with thick, stout culm, branching from the base, 2 to 4 feet high; leaves long, ½ inch or more wide, rough on the margins, otherwise smooth, with the sheath smooth or rough; spikes 1 to 3 inches long, numerous, crowded in a long raceme or a dense panicle, which is rough with stiff hairs; the glumes ovate, rough, abruptly pointed; lower palet of the neutral flower usually bearing a rough awn; varies greatly, sometimes awnless or nearly so, sometimes long awned, especially in the variety hispidum, a very large and coarse form of the species, with the sheaths of the leaves rough, hairy; another variety, muticum, is destitute of the awns and is smooth throughout. Very common in waste places in all parts of the country.

Uses.—Of this grass Dr. C. Mohr says:

An annual, 2 to 3 feet high, bearing its roughly awned flowers in dense one-sided panicles, composed of numerous crowded spikes; it grows luxuriantly, particularly in the lowlands of the coast, is greedily eaten by horses and cattle, and makes a hay of good quality. It is justly regarded as an excellent grass, particularly before it ripens its seed, as in the later stages of its growth the long and stiff awns of its spikes tend to make it somewhat unpalatable.



Panicum Crusgalli.

Panicum sanguinale.

Mr. D. L. Phares, Woodville, Miss., says of this grass: "The hay is very highly esteemed by many farmers. In Northeast Mississippi I have seen large fields of it mowed." This grass should be cut early, while it is juicy and palatable. This will be at the first appearance of the flowers. (See Plate 2.)

Proximate analysis of Panicum crusgalli, from Texas (Barnyard grass, Cock's-foot).

	Per cent.
Oil	1.54
Wax	.57
Sugars	13.87
Gum and dextrin	5.07
Cellulose	32.27
Amylaceous cellulose	21.37
Alkali extract	11.03
Albuminoids	4.14
Ash	10.14
	100.00

Analysis of ash of Panicum crusgalli (Barnyard grass, Cock's-foot).

	Per cent.
Potassium	12.00
Potassium oxide	13.26
Sodium	.37
Sodium oxide	....
Calcium oxide	7.23
Magnesium oxide	5.52
Sulphuric acid	3.69
Phosphoric acid	4.27
Silicic acid	42.18
Chlorine	11.48
	100.00

PANICUM SANGUINALE—Crab grass.

Description.—An annual grass, native of Europe, but thoroughly naturalized in all parts of the country. It springs up in cultivated and waste grounds in the summer, and grows with great rapidity in the hot weather, sending out roots from the lower joints which take firm hold of the soil and enable it to spread in all directions. It is esteemed a great pest in the Northern States, causing a great deal of labor to keep the corn-fields clear of it. In the Southern States it is well known, and is one of the chief hay crops, giving a large yield, and of an excellent quality, if cut before the ripening of its seeds. It is also employed for summer pastures, and answers an excellent purpose during August and September, when the grasses of the spring are old, dry, and perhaps burned by the sun. The flowers are on slender spikes, which are 4 to 6 inches long, and all crowded near the top of the stem, like those of the yard grass (*Eleusine indica*), but more slender. It will be easily recognized by the figure without an extended description.

Uses.—Professor Killebrew, Tennessee, says:

It is a fine pasture grass, although it has but few base leaves and forms no sward, yet it sends out numerous stems, branching freely at the base. It serves a most useful purpose in stock husbandry, and the northern farmers would congratulate themselves very much if they had it to turn their cattle on while the clover fields and meadows are parched up with summer heat. It fills all our corn-fields, and many persons pull it out, which is a tedious process. It makes a sweet hay, and horses are exceedingly fond of it, leaving the best hay to eat it. (See Plate 3.)

Proximate analysis of Panicum sanguinale, from Alabama (Crab grass, Finger grass.)

	Per cent.
Oil	2.87
Wax	.02
Sugars	9.88
Gum and dextrin	5.60
Cellulose	32.80
Amylaceous cellulose	24.29
Alkali extract	3.87
Albuminoids	9.99
Ash	10.68
	100.00

Analysis of ash of Panicum sanguinale (Crab grass, Finger grass).

	Per cent.
Potassium	6.67
Potassium oxide	33.56
Sodium	----
Sodium oxide	----
Calcium oxide	4.40
Magnesium oxide	7.98
Sulphuric acid	4.02
Phosphoric acid	6.40
Silicic acid	30.93
Chlorine	6.04
	100.00

PANICUM VIRGATUM—Tall Panic grass, Switch grass.

Description.—A tall perennial grass, 3 to 5 feet high, growing mostly in clumps in wet or moist soil, particularly near the coast. The culms are firm, unbranched, except near the top, where they open into an ample spreading panicle, sometimes 2 feet long; the leaves are from 1 to 2 feet long, flat, rough-margined, ⅓ to ½ inch broad. The spikelets are large, ⅙ inch long, ovate and pointed, on smooth flexuous pedicels; the glumes are long-pointed, the lower one-half as long as the upper. The lower flower has 2 palets and contains 3 stamens; the upper or perfect flower is obtusish and shorter than the upper glume. The branches of the panicle are at first erect and appressed, finally spreading; they are in whorls around the stem, 5 to 9 branches in the lower whorls, fewer in the upper ones.

Uses.—This is a good and prolific grass, if cut when young; when ripe it becomes harsh and unpalatable. It forms a considerable constituent of the native grasses of the prairies, particularly of moist localities. (See Plate 4.)

Proximate analyses of Panicum virgatum (Tall Panic grass, Switch grass).

No. 1 Texas, No. 2 Alabama.

	No. 1. Per cent.	No. 2. Per cent.
Oil	1.25	1.75
Wax	.45	.17
Sugars	7.05	9.61
Gum and dextrin	3.37	3.02
Cellulose	37.38	28.87
Amylaceous cellulose	27.59	25.94
Alkali extract	13.06	22.50
Albuminoids	5.01	4.58
Ash	4.84	3.56
	100.00	100.00

Panicum virgatum.

Analyses of ash of Panicum virgatum (Tall Panic grass, Switch grass).

	No. 1. Per cent.	No. 2. Per cent.
Potassium	3.36	1.54
Potassium oxide	18.76	22.53
Sodium	1.22	1.74
Sodium oxide	----	----
Calcium oxide	7.87	7.39
Magnesium oxide	3.63	7.98
Sulphuric acid	3.56	5.29
Phosphoric acid	5.50	4.37
Silicic acid	51.17	45.10
Chlorine	4.93	4.06
	100.00	100.00

PANICUM FILIFORME—Slender Crab grass.

Description.—This is a native species of Crab grass. It is annual, growing with erect, slender culms, which are terminated by 3 to 5 slender, erect spikes of flowers. The leaves are 1 to 2 inches long, smooth below, sometimes a little hairy above, the lower sheaths hairy.

Uses.—It grows mostly in dry sandy soil, and is of little value, from its scanty foliage and thin wiry stems.

Proximate analysis of Panicum filiforme, from Alabama (Slender Crab grass).

	Per cent.
Oil	1.29
Wax	.25
Sugars	5.89
Gum and dextrin	4.67
Cellulose	26.78
Amylaceous cellulose	29.96
Alkali extract	23.19
Albuminoids	3.32
Ash	4.65
	100.00

Analysis of ash of Panicum filiforme (Slender Crab grass).

	Per cent.
Potassium	13.41
Potassium oxide	12.98
Sodium	----
Sodium oxide	----
Calcium oxide	4.69
Magnesium oxide	5.18
Sulphuric acid	4.84
Phosphoric acid	6.37
Silicic acid	40.36
Chlorine	12.17
	100.00

PANICUM JUMENTORUM—Guinea grass.

Description.—This is a perennial grass, of strong, vigorous growth, a native of Africa, extensively cultivated throughout the tropics. Mr. Charles Mohr, of Mobile, who sent the specimens for analysis, says:

Uses.—It is planted with us in the beginning of April; admits the first cutting during the last week of May; it makes very large bunches, and is to be cut before extending to the height of about 18 inches. In that stage it is very sweet, tender, and easily cured as hay. In moderately fertilized land and favorable seasons it can be cut every five or six weeks, yielding, by its throwing out numerous stolons, increased crops until killed down by frost. The roots are easily protected during the winter by a good covering with ground, like the rattoons of sugar-cane, and allowing of a manifold division, afford the best means of propagation. These root-cuttings are set out in March or the beginning of April.

This grass must not be confounded with the *Sorghum halapense* or Johnson grass, which is often improperly called Guinea grass from its similar habit and appearance.

Proximate analysis of Panicum jumentorum, from Alabama (True Guinea grass).

	Per cent.
Oil	1.27
Wax	.31
Sugars	5.93
Gum and dextrin	4.51
Cellulose	31.76
Amylaceous cellulose	16.30
Alkali extract	22.60
Albuminoids	8.95
Ash	8.37
	100.00

Analysis of ash of Panicum jumentorum (True Guinea grass).

	Per cent.
Potassium	8.57
Potassium oxide	35.93
Sodium	....
Sodium oxide	....
Calcium oxide	10.18
Magnesium oxide	14.16
Sulphuric acid	2.51
Phosphoric acid	4.37
Silicic acid	16.51
Chlorine	7.77
	100.00

PANICUM OBTUSUM—Obtuse-flowered Panic grass.

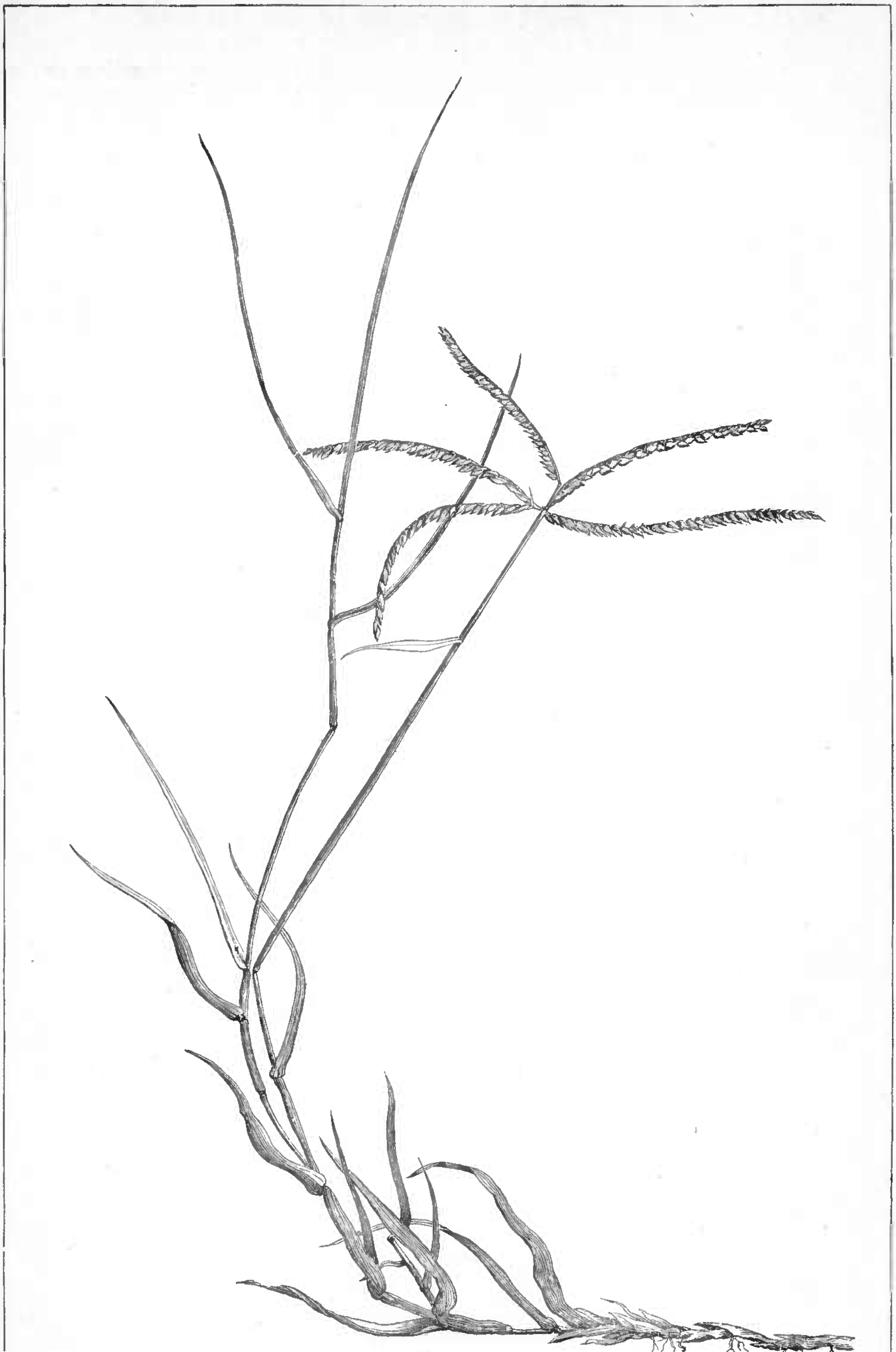
Description.—This grass is similar in appearance to the *Panicum Texanum*, or Texas Millet, but is lower and less vigorous in growth, with narrower panicles and narrower and smoother leaves. It grows in South America, Mexico, New Mexico, and Texas. The specimens for analysis were sent by Prof. S. B. Buckley, of Austin, Tex. We do not know that it extends east of the Mississippi River. We are not aware that it has been tried with reference to its agricultural value.

Proximate analysis of Panicum obtusum, from Texas.

	Per cent.
Oil	1.77
Wax	.50
Sugars	9.68
Gum and dextrin	5.74
Cellulose	33.32
Amylaceous cellulose	24.21
Alkali extract	8.75
Albuminoids	7.28
Ash	8.75
	100.00

Analysis of ash of Panicum obtusum.

	Per cent.
Potassium	4.62
Potassium oxide	21.65
Sodium	....
Sodium oxide	....
Calcium oxide	5.91
Magnesium oxide	3.13
Sulphuric acid	6.71
Phosphoric acid	5.18
Silicic acid	48.60
Chlorine	4.20
	100.00



CYNODON DACTYLON.

CYNODON DACTYLON—Bermuda grass, Wire grass.

Description.—A low, creeping perennial grass, with abundant short leaves at the base, sparingly sending up slender, nearly leafless flower stalks, with 3 to 5 slender, diverging spikes at the summit. The flowers are arranged in a close row along one side of these spikes. The spikelets are one-flowered, with a short pedicelled rudiment of a second flower. The glumes are pointed, but without awns; the lower palet boat-shaped.

Habit and uses.—This grass is a native of Europe, and is abundantly naturalized in many other countries. It is said to be a common pasture grass in the West Indies. In the Southern States it has long been the chief reliance for pasture, and has been extravagantly praised by some, and cursed by others who find it difficult to eradicate it when once established. Its properties have been very fully discussed in southern journals, particularly in the "Manual of Grasses," by Mr. C. W. Howard, and in the "Grasses of Tennessee," by Prof. Killebrew. Mr. C. Mohr says:

> It thrives in the arid, barren drift sands of the sea-shore, covering them by its long, creeping stems, whose deeply penetrating roots impart firmness to a soil which else would remain devoid of vegetation. It is esteemed one of the most valuable of our grasses, either in the pasture or cured as hay.

Col. T. C. Howard, of Georgia, says:

> The desideratum to the South is a grass that is perennial, nutritious, and adapted to the climate. While we have grasses and forage plants that do well when nursed, we have few that live and thrive here as in their native habitat. The Bermuda and Crab grasses are at home in the South. They not only live, but live in spite of neglect, and when petted and encouraged they make such grateful returns as astonish the benefactor.

It seems that it rarely ripens any seed, and the usual method of reproducing it is to chop up the roots with a cutting-knife, sow them broadcast, and plow under shallow. Colonel Lane says:

> Upon our ordinary upland I have found no difficulty in destroying it by close cultivation in cotton for two years. It requires a few extra plowings to get the sod thoroughly broken to pieces.

Professor Killebrew writes:

> In Louisiana, Texas, and the South generally it is, and has been, the chief reliance for pasture for a long time, and the immense herds of cattle on the southern prairies subsist principally on this food. It revels on sandy soils, and has been grown extensively on the sandy hills of Virginia and North and South Carolina. It is used extensively on the southern rivers to hold the levees and the embankments of the roads. It will throw its runners over a rock six feet across, and soon hide it from view, or it will run down the sides of the deepest gully and stop its washing. Hogs thrive upon its succulent roots, and horses and cattle upon its foliage. It has the capacity to withstand any amount of heat and drought, and months that are so dry as to check the growth of Blue grass will only make the Bermuda greener and more thrifty. (See Plate 5.)

Proximate analyses of Cynodon dactylon (Bermuda grass, Wire grass, Scutch grass).

No. 1 from Georgia, No. 2 from Alabama.

	No. 1. Per cent.	No. 2. Per cent
Oil	1.86	1.23
Wax	.36	.36
Sugars	6.56	8.17
Gum and dextrin	9.29	3.59
Cellulose	24.55	23.57
Amylaceous cellulose	27.43	29.30
Alkali extract	12.64	12.23
Albuminoids	11.15	13.59
Ash	6.16	7.96
	100.00	100.00

Analyses of ash of Cynodon dactylon (Bermuda grass, Wire grass, Scutch grass).

	No. 1. Per cent.	No. 2. Per cent.
Potassium	6.66	9.61
Potassium oxide	22.99	22.89
Sodium	.....	.42
Sodium oxide	.....	.....
Calcium oxide	13.44	7.99
Magnesium oxide	5.00	2.96
Sulphuric acid	9.37	11.31
Phosphoric acid	6.20	5.09
Silicic acid	30.29	30.27
Chlorine	6.05	9.46
	100.00	100.00

ELEUSINE INDICA—Crow-foot, Yard grass, Dog's-tail.

Description.—This is an annual grass belonging to tropical countries, but now naturalized in most temperate climates. In the Southern States it is found in every door-yard and in all waste places. The culms or flowering stems rise from 6 to 18 inches high, and are usually coarse and thick; the summit is crowned with from 2 to 6 spikes, resembling those of common Crab grass, *Panicum sanguinale*, but much thicker and heavier. It makes a thick bed of rather coarse but rather long and wide leaves, and takes such a firm hold on the soil that it is difficult to pull up a clump by hand. The spikelets are crowded on one side of the flattened spikes, 2 to 6 flowered, and with pointless glumes.

Uses.—It does not seem to be very highly recommended for cultivation in the South, although it is said to form good and lasting picking for stock. (See Plate 6.)

Proximate analyses of Eleusine Indica (Crab grass, Yard grass, Crow-foot, Dog's-tail).

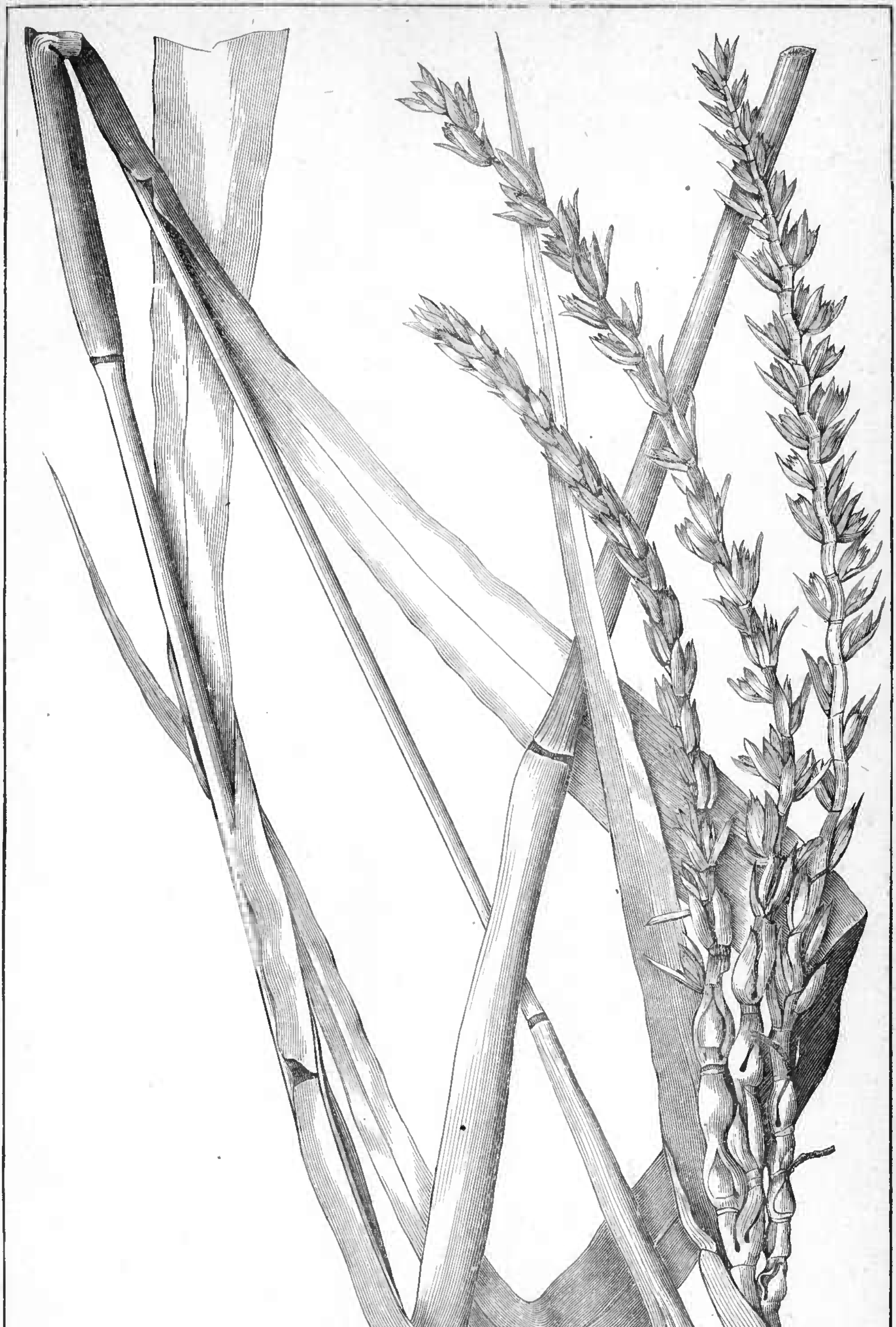
No. 1 from Texas, No. 2 from Georgia, No. 3 from Alabama.

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.
Oil	1.78	1.72	2.27
Wax	.38	.35	.29
Sugars	11.92	13.29	8.69
Gum and dextrin	6.33	5.84	4.98
Cellulose	31.29	22.38	21.53
Amylaceous cellulose	25.46	26.37	21.97
Alkali extract	.00	10.44	20.97
Albuminoids	13.72	13.28	12.23
Ash	9.12	6.33	7.07
	100.00	100.00	100.00

Analyses of ash of Eleusine Indica (Crab grass, Yard grass, Crow-foot, Dog's-tail).

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.
Potassium	9.52	7.39	4.55
Potassium oxide	10.27	24.79	30.98
Sodium	1.26	....	3.55
Sodium oxide	....	....	....
Calcium oxide	10.27	13.65	11.10
Magnesium oxide	4.10	7.38	5.57
Sulphuric acid	4.24	5.79	8.55
Phosphoric acid	2.69	9.68	9.84
Silicic acid	47.56	24.61	16.25
Chlorine	10.09	6.71	9.61
	100.00	100.00	100.00

Eleusine Indica.



TRIPSACUM DACTYLOIDES.

DACTYLOCTENIUM ÆGYPTIACUM—Crow-foot grass.

Description.—This is an annual grass somewhat resembling the preceding (*Eleusine*), but coarser and stiffer, and of less value. The stems are often rooting at the base, with commonly four acutely pointed stiff spikes at the top of the culm, which are shorter than those of the *Eleusine Indica*. It is not cultivated, but occurs abundantly in some localities in waste or neglected grounds.

Proximate analysis of Dactyloctenium Ægyptiacum, from Georgia (Crow-foot grass).

	Per cent.
Oil	1.64
Wax	.32
Sugars	10.96
Gum and dextrin	5.60
Cellulose	17.48
Amylaceous cellulose	31.63
Alkali extract	16.46
Albuminoids	9.01
Ash	6.90
	100.00

Analysis of ash of Dactyloctenium Ægyptiacum (Crow-foot grass).

	Per cent.
Potassium	7 50
Potassium oxide	21.20
Sodium	----
Sodium oxide	----
Calcium oxide	20.67
Magnesium oxide	6.91
Sulphuric acid	4.42
Phosphoric acid	8.37
Silicic acid	24.17
Chlorine	6.76
	100.00

TRIPSACUM DACTYLOIDES—Gama grass.

Description.—A tall perennial grass, with solid culms, broad and flat leaves, and with flower-spikes from 4 to 8 inches long, produced from the side joints or from the top, either singly or 2 or 3 together. The upper portion of these spikes is staminate or male, and the lower portion pistillate and producing the seeds. It grows from 3 to 6 feet high, with large broad leaves resembling those of Indian corn. The upper or male portion of the flower-spikes drops off after flowering, and the fertile portion easily breaks up into short joints. These joints are thick and polished, and the flowers and seeds are deeply imbedded in them.

Uses.—Mr. Howard in his Manual of Grasses, says:

This is a native of the South, from the mountains to the coast. The seed stem runs up to the height of five to seven feet. The seeds break off from the stem as if in a joint, a single seed at a time. The leaves resemble those of corn. When cut before the seed stems shoot up they make a coarse but nutritious hay. It may be cut three or four times during the season. The quantity of forage which can be made from it is enormous. Both cattle and horses are fond of the hay. The roots are almost as large and strong as cane roots. It would require a team of four to six oxen to plough it up. It can, however, be easily killed by close grazing, and the mass of dead roots would certainly greatly enrich the land. As the seeds of this grass vegetate with uncertainty, it is usually propagated by setting out slips of the roots about 2 feet apart each way. On rich land the tussocks will soon meet. In the absence of the finer hay grasses this grass will be found an abundant and excellent substitute. The hay made from it is very like corn fodder, is quite equal to it in value, and may be saved at a tithe of the expense.

Professor Killibrew, of Tennessee, gives a similar account of the grass. (See Plate 7.)

Proximate analysis of Tripsacum dactyloides, from Mississippi (Gama grass).

	Per cent.
Oil	1.72
Wax	.68
Sugars	8.84
Gum and dextrin	3.66
Cellulose	26.59
Amylaceous cellulose	20.84
Alkali extract	23.09
Albuminoids	8.62
Ash	5.96
	100.00

Analysis of ash of Tripsacum dactyloides (Gama grass).

	Per cent.
Potassium	6.30
Potassium oxide	29.06
Sodium	4.77
Sodium oxide	....
Calcium oxide	1.64
Magnesium oxide	1.07
Sulphuric acid	3.69
Phosphoric acid	2.52
Silicic acid	37.87
Chlorine	13.08
	100.00

SORGHUM HALAPENSE—Johnson grass, False Guinea grass.

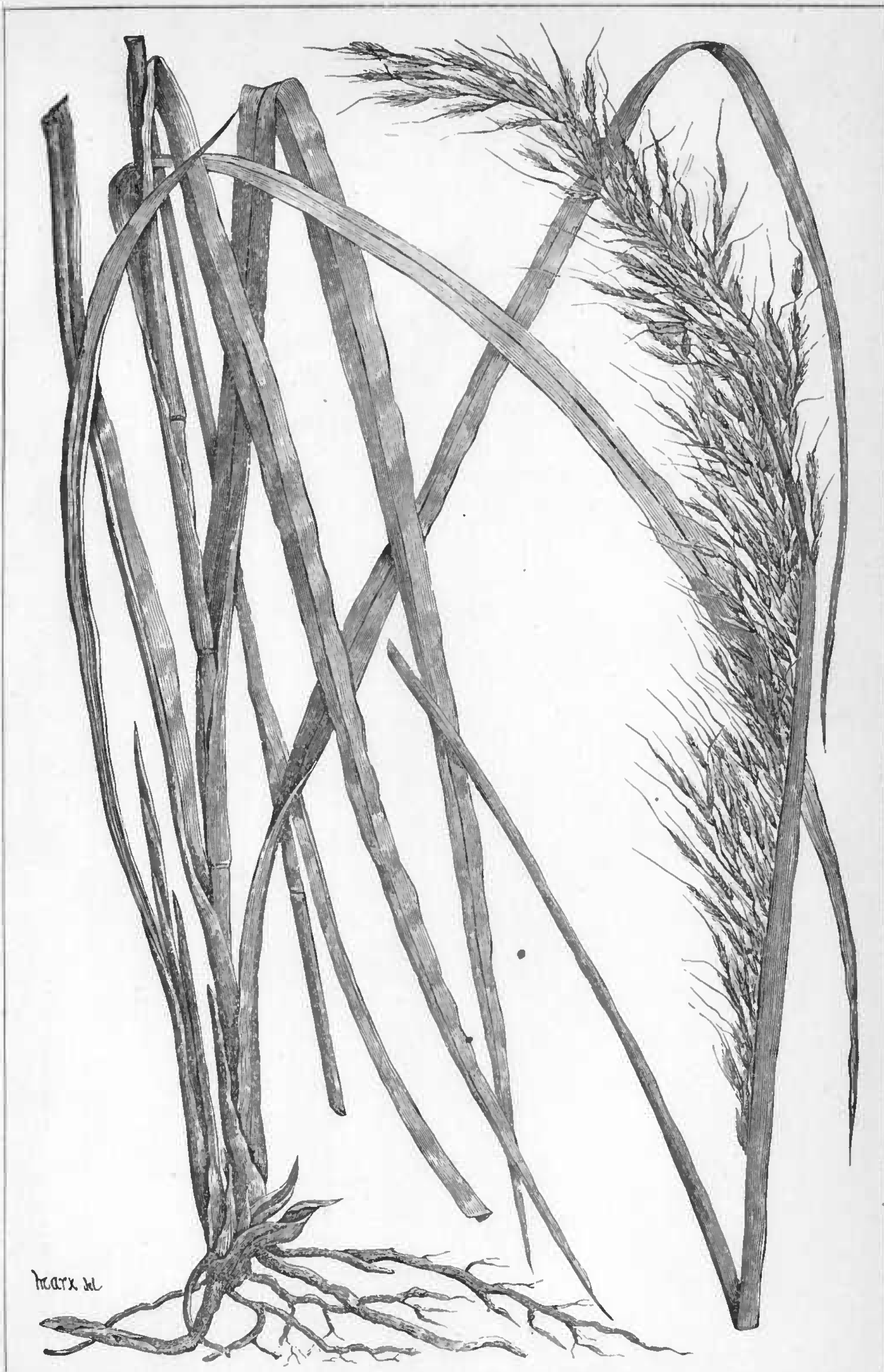
Description.—A perennial grass with strong, vigorous roots, and abundance of long and tolerably broad leaves. Its stems attain a height of 5 to 6 feet, with a large and spreading panicle. The flowers and seeds are much like those of broom-corn, but the panicle is finer and more spreading. An account of this grass is given in the annual report of this department for 1874. It has been much discussed in the Southern journals. It has been dreaded by planters because it seems almost impossible to exterminate it where it has once been established.

Uses.—Mr. Howard, in his manual, publishes a letter from Mr. N. B. Moore, of Augusta, Ga., concerning this grass. He says this gentleman is certainly the highest authority in Southern grass-culture. It is his opinion, after an experience of upward of forty years in cultivating grasses, that this grass is to be preferred to all others. It is perennial, is as nutritious as any other; when once set it is difficult to eradicate; will grow on ordinary land, and yields abundantly." (See Plate 8.)

Proximate analysis of Sorghum halapense, from Alabama (Means grass, Johnson grass, Egyptian grass).

	Per cent.
Oil	2.25
Wax	.61
Sugar	7.37
Gum and dextrin	5.14
Cellulose	25.15
Amylaceous cellulose	25.87
Alkali extract	15.58
Albuminoids	13.18
Ash	4.85
	100.00

SORGHUM HALAPENSE.



SORGHUM NUTANS.

Analysis of ash of Sorghum halapense (Means grass, Johnson grass, Egyptian grass.)

	Per cent.
Potassium	3.68
Potassium oxide	35.72
Sodium	.81
Sodium oxide	----
Calcium oxide	12.87
Magnesium oxide	6.73
Sulphuric acid	2.96
Phosphoric acid	10.44
Silicic acid	22.21
Chlorine	4.58
	100.00

SORGHUM NUTANS—Indian grass, Wood grass.

Description.—This is a perennial, tall grass, having a wide range over all the country east of the Rocky Mountains. It grows rather sparsely, and forms a thin bed of grass. The stalks are 3 to 4 feet high, smooth, hollow, straight, and having at the top a narrow panicle of handsome straw-colored or brownish flowers, which are rather drooping in fruit. The spikelets are 2 or 3 together on the slender branches of the loose panicle; the lateral ones sterile or reduced to a mere vestige; the middle or terminal one fertile. The palet of the fertile flower has a twisted awn half an inch to an inch long.

Uses.—This grass has not usually been considered of much agricultural value, but it forms an important part of the native grass of the Western prairies, and, if cut early, forms good and nutritious hay. In the Southern States and in Texas there are two additional species or varieties which are not materially different. (See Plate 9.)

Proximate analysis of Sorghum nutans var., from Texas, (Indian grass, Wood grass).

	Per cent.
Oil	1.57
Wax	.10
Sugars	7.27
Gum and dextrin	3.75
Cellulose	36.70
Amylaceous cellulose	27.25
Alkali extract	14.44
Albuminoids	3.29
Ash	5.63
	100.00

Analysis of ash of Sorghum nutans var. (Indian grass, Wood grass).

	Per cent.
Potassium	6.74
Potassium oxide	16.84
Sodium	----
Sodium oxide	----
Calcium oxide	2.92
Magnesium oxide	1.36
Sulphuric acid	2.13
Phosphoric acid	2.35
Silicic acid	61.55
Chlorine	6.11
	100.00

BROMUS UNIOLOIDES—Schrader's grass, Rescue grass.

This is one of the so-called winter grasses; that is, it makes a large share of its growth during the winter months. It belongs to the Chess or Cheat family. In its early growth it spreads and produces a large

amount of leaves; early in the spring it sends up its flower stalks, which grow about 3 feet high, with a rather large, open, spreading panicle, the ends of the branchlets bearing the large flattened spikelets, which, when mature, hang gracefully upon their stems, giving them quite an ornamental appearance. These spikelets are from an inch to an inch and a half in length, and composed of two acute lanceolate glumes at the base, and from 7 to 10 flowers, arranged in two rows alternate on each side of the axis. The flowers are lanceolate, or ovate lanceolate, the lower palet extending into a fine point or short awn.

During several years past this grass has been sent to this department, chiefly from Louisiana and Texas, and has been much commended. Many years since the same grass was distributed and experimented with under the name of Australian oats, or *Bromus Schraderi.* It is not adapted to use in a country with severe winters, and hence did not give satisfaction in all places. Mr. C. Mohr, of Mobile, says of it:

Only of late years found spreading in different parts of this State; makes its appearance in February, grows in tufts, its numerous leafy stems growing from 2 to 3 feet high; it ripens the seed in May; affords in the earlier months of spring a much-relished nutritious food, as well as a good hay.

Under date of March 4, 1878, Mr. Williams writes from San Antonio, Tex., describing the introduction and spreading of a patch of this grass. He says:

Inasmuch as Western Texas is the great stock-producing section of the Southwest, and considering the fact that pasturage is scanty, particularly in February, stunting the growth of young cattle, this seems wonderfully adapted to supply just what is greatly wanted, both for milch cows, calves, colts, and ewes just dropping lambs; and besides, this grass grows well on the thinnest soil and crowds out weeds, maturing in March and early April, whilst not interfering with the native *mesquite.* I therefore regard this grass as a wonderful and most important discovery.

This grass is said to have been introduced into Georgia by General Iverson, of Columbus, and by him called Rescue grass. The favorable opinion which it at first received does not seem to have been well sustained in that State. (See Plate 10, one-half natural size.)

Proximate analysis of Bromus unioloides, from department grounds (Schrader's grass, Rescue grass).

	Per cent.
Oil	2.99
Wax	.24
Sugars	14.36
Gum and dextrin	1.00
Cellulose	24.31
Amylaceous cellulose	23.74
Alkali extract	13.13
Albuminoids	12.45
Ash	7.78
	100.00

Analysis of ash of Bromus unioloides (Schrader's grass, Rescue grass).

	Per cent.
Potassium	16.38
Potassium oxide	37.20
Sodium	1.27
Calcium oxide	4.43
Magnesium oxide	4.64
Sulphuric acid	5.61
Phosphoric acid	8.79
Silicic acid	4.84
Chlorine	16.84
	100.00

BROMUS UNIOLOIDES,

ANDROPOGON SCOPARIUS.

ANDROPOGON FURCATUS.

BROMUS CARINATUS—California Brome grass.

A package of this grass was sent to the department for analysis by Mr. E. Hall, Athens, Ill. It was grown by him from California seed. It closely resembles the preceding species, having smaller and lighter spikelets, and is probably similar in its growth and properties.

Proximate analysis of Bromus carinatus, from Illinois (California Brome grass).

	Per cent.
Oil	2.46
Wax	.24
Sugars	9.38
Gum and dextrin	4.56
Cellulose	26.90
Amylaceous cellulose	17.02
Alkali extract	19.15
Albuminoids	9.88
Ash	10.31
	100.00

Analysis of ash of Bromus carinatus (California Brome grass).

	Per cent.
Potassium	----
Potassium oxide	31.61
Sodium	2.98
Sodium oxide	2.17
Calcium oxide	6.19
Magnesium oxide	2.19
Sulphuric acid	3.94
Phosphoric acid	9.29
Silicic acid	38.33
Chlorine	3.30
	100.00

ANDROPOGON SCOPARIUS—Broom grass, Broom sedge.

Description.—A perennial grass with tough wiry stems, growing 2 to 3 feet high, with the narrow flower spikes coming out from the side joints and also at the top. The spikelets are in pairs on each joint of the slender axis, one of the flowers is sterile and fringed with soft spreading hairs, the other perfect, and with a small twisted awn.

Uses.—It grows mostly in dry sterile soil—"a great eyesore if it takes possession of meadows, but a good pasture grass before it shoots up its culms, after which stock will touch it no more." Mr. C. Mohr, Mobile, says of it: "One of our most common grasses, covering old fields and fence-rows, and extensively growing in the dry sandy soil of the pine woods. Much despised as this grass is as a troublesome, unsightly weed, it has its good qualities which entitle it to a more charitable consideration. In the dry pine woods it contributes, while green and tender, a large share to the sustenance of stock." (See Plate 11.)

Proximate analysis of Andropogon scoparius from Alabama (Broom grass, Broom sedge, Purple Wood grass.)

	Per cent.
Oil	1.16
Wax	.43
Sugars	5.37
Gum and dextrin	3.44
Cellulose	24.91
Amylaceous cellulose	26.51
Alkali extract	28.07
Albuminoids	6.21
Ash	3.90
	100.00

Analysis of ash of andropogon scoparius (Broom grass, Broom sedge, Purple Wood grass)

	Per cent.
Potassium	15.70
Potassium oxide	.....
Sodium	.....
Sodium oxide	.....
Calcium oxide	2.12
Magnesium oxide	.58
Sulphuric acid	Trace.
Phosphoric acid	1.33
Silicic acid	64.62
Chlorine	15.65
	100.00

Andropogon furcatus, *Andropogon Virginicus*, and *Andropogon macrourus* are other species of this genus, which have similar characters with the preceding. In the great prairie region of the West these form an important quantity of the native grasses. Although useful as a resource for stock having a range over uncultivated fields or grounds, their place should, as early as possible, be filled with more valuable grasses. (Plate 12 is *Andropogon furcatus.*)

Proximate analysis of Andropogon Virginicus, from Texas (Broom sedge, Sedge grass).

	Per cent.
Oil	1.24
Wax	.47
Sugars	7.98
Gum and dextrin	5.02
Cellulose	33.73
Amylaceous cellulose	26.32
Alkali extract	5.80
Albuminoids	13.00
Ash	6.44
	100.00

Analysis of ash of Andropogon Virginicus (Broom sedge, Sedge grass).

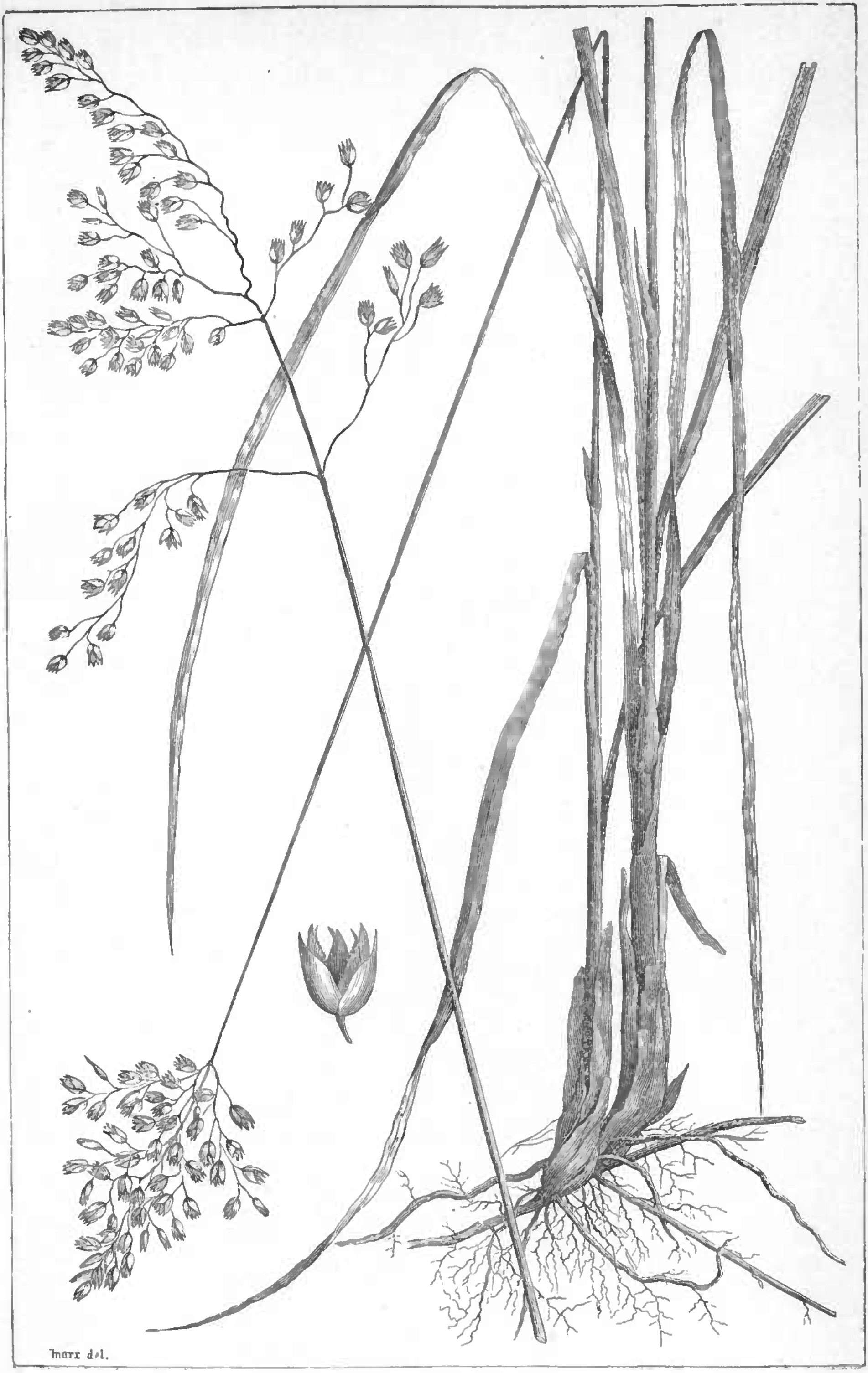
	Per cent.
Potassium	7.01
Potassium oxide	13.93
Sodium	.....
Sodium oxide	.....
Calcium oxide	6.76
Magnesium oxide	1.83
Sulphuric acid	2.80
Phosphoric acid	2.97
Silicic acid	58.33
Chlorine	6.37
	100.00

HIEROCHLOA BOREALIS—Vanilla or Seneca grass.

Description.—This is a grass of northern latitudes, growing in moist meadows near the coast, also in low marshy ground in some parts of Illinois and other States bordering the Great Lakes, and in the mountains of Colorado and northward.

A package of the grass for analysis was sent by Mr. E. Hall, Athens, Ill. The name *Hierochloa* means sacred grass, so called because this, among other sweet-scented grasses, was strewn before the church-doors on saints' days, in the north of Europe.

The culms grow from one to two feet high, with short lanceolate leaves, and an open pyramidal panicle, from 2 to 5 inches long. The spikelets



HIEROCHLOA BOREALIS.

SPOROBOLUS INDICUS.

are 3-flowered; the flowers all with two palets; the two lower flowers staminate only, often awned on the middle of the back or near the tip; the uppermost one perfect, short pedicelled, scarcely as long as the others, and awnless. The spikelets are chestnut-colored and rather ornamental.

Uses.—Experiments are wanting to determine the availability of this grass for agricultural uses. (See Plate 13.)

Proximate analysis of Hierochloa borealis, from Illinois (Vanilla grass, Seneca grass).

	Per cent.
Oil	3.75
Wax	.37
Sugars	12.71
Gum and dextrin	5.42
Cellulose	23.30
Amylaceous cellulose	23.15
Alkali extract	8.58
Albuminoids	14.31
Ash	8.41
	100.00

Analysis of ash of Hierochloa borealis (Vanilla grass, Seneca grass).

	Per cent.
Potassium	4.54
Potassium oxide	31.51
Sodium	.25
Sodium oxide	.....
Calcium oxide	3.97
Magnesium oxide	2.54
Sulphuric acid	2.55
Phosphoric acid	7.42
Silicic acid	42.73
Chlorine	4.49
	100.00

SPOROBOLUS INDICUS—Smut grass.

Description.—A native of India, but now spread over many countries. It occurs more or less abundantly in all the Southern States, and is called smut-grass, from the fact that after flowering the heads become affected with a blackish smut.

Uses.—Mr. D. L. Phares, who sends it from Mississippi, says that it grows luxuriantly in uncultivated lands, and is eaten by cattle and horses, and seems valuable. Dr. Gattinger, of Nashville, Tenn., says:

> All parts of the plant are equally pliant and succulent. It sprouts again after being pastured down, with numerous new culms, and its growing season lasts from May till frost. The culms stand about two feet high, and, as far as I have observed, I found it always growing in patches. It grows in low and small tufts, and sticks firmly to the soil. I would very earnestly recommend to try it under cultivation.

The flowers are borne in a long, narrow, spike-like panicle. The spikelets are single flowered, with unequal glumes. (See Plate 14.)

Proximate analysis of Sporobolus Indicus, from Mississippi (Smut grass, Indian Drop-seed).

	Per cent.
Oil	2.99
Wax	.31
Sugars	8.17
Gum and dextrin	2.75
Cellulose	25.91
Amylaceous cellulose	27.06
Alkali extract	14.16
Albuminoids	12.46
Ash	6.19
	100.00

Analysis of ash of Sporobolis Indicus (Smut grass, Indian Drop-seed).

	Per cent.
Potassium	12.16
Potassium oxide	33.53
Sodium	.....
Sodium oxide	.....
Calcium oxide	2.64
Magnesium oxide	2.66
Sulphuric acid	4.60
Phosphoric acid	6.02
Silicic acid	27.36
Chlorine	11.03
	100.00

AGROSTIS EXARATA—Northern Red-top.

Description.—This may be called Mountain or Northern Red-top. The specimens analyzed were sent to the Department by Mr. Theodore Louis, of Dunn County, Wisconsin, where the grass is a native of the low grounds. It is more slender in its growth than the common cultivated red top (*Agrostis vulgaris*). It is a native of the Rocky Mountain region; on the Pacific slope presenting a good deal of variation in form and size, so much so that it has received several specific names, although more extended observations are needed to establish accurately the boundaries of the species.

Uses.—There is little doubt that this grass would be suited to growth in the northern portions of our country, and on moist meadows and bottom lands would probably prove valuable. (See Plate 15.)

Proximate analysis of Agrostis exarata, from Wisconsin (Native Red-top, Mountain Red-top).

	Per cent.
Oil	2.12
Wax	.19
Sugars	7.06
Gum and dextrin	8.95
Cellulose	24.59
Amylaceous cellulose	24.62
Alkali extract	16.20
Albuminoids	10.65
Ash	5.62
	100.00

Analysis of ash of Agrostis exarata (Native Red-top, Mountain Red-top).

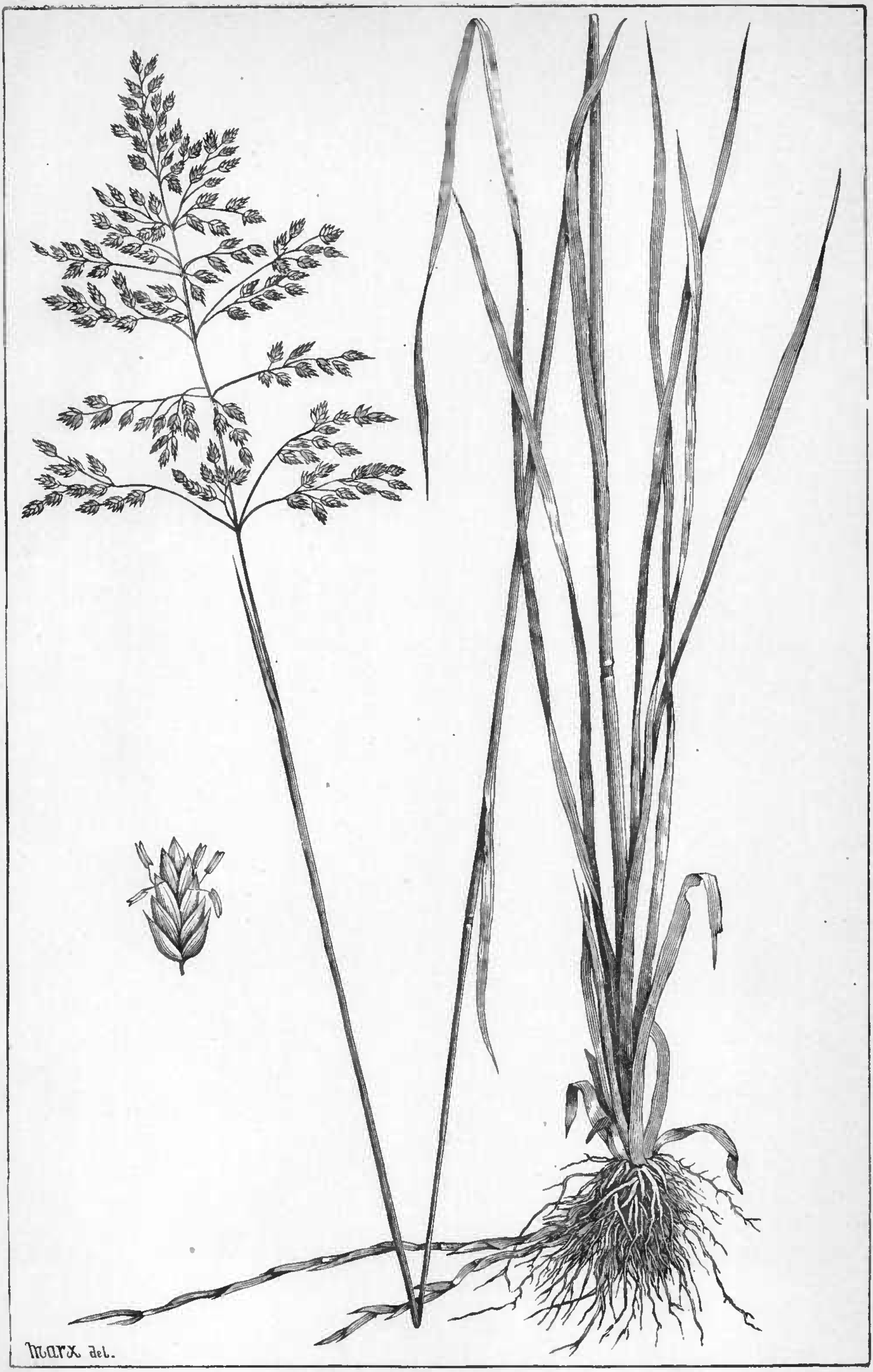
	Per cent.
Potassium	3.97
Potassium oxide	38.41
Sodium	.....
Sodium oxide	.....
Calcium oxide	5.61
Magnesium oxide	3.84
Sulphuric acid	1.93
Phosphoric acid	8.01
Silicic acid	34.63
Chlorine	3.60
	100.00

POA SEROTINA—Fowl Meadow grass.

Description.—This grass is closely related to the Kentucky Blue grass (*Poa pratensis*). It grows taller than that species, and is better adapted for a meadow grass than for pasture. The culms are erect, 2 to 3 feet

AGROSTIS EXARATA.

POA SEROTINA.



POA PRATENSIS.

high, without running root-stocks. The leaves are narrowly linear, 3 to 6 inches long and about 2 to 3 lines wide. The panicle is from 5 to 10 inches long, composed of 5 to 7 whorls of branches, mostly in fives, rough, varying in length from 2 to 6 inches; the flowers toward the ends of the branches; spikelets 1 to 2 lines long, 2 to 4 flowers, acute, short pedicelled, green, sometimes tinged with purple. The flowers and glumes are narrow, the lower palet very obscurely nerved, and more or less webby at the base.

Uses.—This species is most common in the Northern States, particularly north of Pennsylvania. It is a good grass for moist meadows. In Wisconsin, where many natural meadows of this grass occur, it is highly esteemed. (See Plate 16.)

Proximate analysis of Poa serotina, from Wisconsin (Fowl Meadow grass).

	Per cent.
Oil	1.95
Wax	1.53
Sugars	9.33
Gum and dextrin	7.49
Cellulose	25.62
Amylaceous cellulose	25.24
Alkali extract	15.19
Albuminoids	8.91
Ash	4.74
	100.00

Analysis of ash of Poa serotina (Fowl Meadow grass).

	Per cent.
Potassium	2.79
Potassium oxide	31.71
Sodium	.83
Sodium oxide	....
Calcium oxide	6.70
Magnesium oxide	2.92
Sulphuric acid	3.35
Phosphoric acid	10.80
Silicic acid	37.10
Chlorine	3.80
	100.00

POA PRATENSIS—Kentucky Blue grass.

Description.—This grass is too well known to need an extended description. Professor Killebrew, of Tennessee, says:

> It would seem a work of supererogation to argue as to the advantages of cultivating this grass. All know its benefits, and all see around them the great increase in the value of the land covered by it. It grows readily in all parts of the United States north of latitude 40°, and lower down on suitable soils. It flowers in the earliest summer, and gives rich pasturage, except in the driest months, all the year. It varies in size in different localities according to soil and climate.

Uses.—From the unexampled success its cultivation has met with in Kentucky it has acquired the name of Kentucky Blue grass, though in the New England States it is known by the name of June grass. In all the middle portions of the United States it forms the principal constituent of the turf, though its excellence is rather depreciated in the Eastern States. "In some sections it has been used as a hay, but it is not a success as a meadow grass, its chief excellence being exhibited as a pasture grass. It endures the frosts of winter better than any other grass we have, and if allowed to grow rank during the fall months, it will turn over and hide beneath its covering the most luxuriant of winter croppings. Many persons pass their stock through the entire winter on it alone, feeding only when the ground is covered with snow." (See Plate 17.)

Proximate analysis of Poa pratensis, from Wisconsin (June grass, Blue grass).

	Per cent.
Oil	1.82
Wax	1.04
Sugars	9.61
Gum and dextrin	3.14
Cellulose	27.94
Amylaceous cellulose	22.53
Alkali extract	17.20
Albuminoids	11.54
Ash	5.18
	100.00

Analysis of ash of Poa pratensis (June grass, Blue grass).

	Per cent.
Potassium	6.95
Potassium oxide	33.81
Sodium	.....
Sodium oxide	.....
Calcium oxide	4.81
Magnesium oxide	3.23
Sulphuric acid	4.76
Phosphoric acid	9.89
Silicic acid	30.25
Chlorine	6.30
	100.00

TRICUSPIS SESLERIOIDES—Tall Red-top.

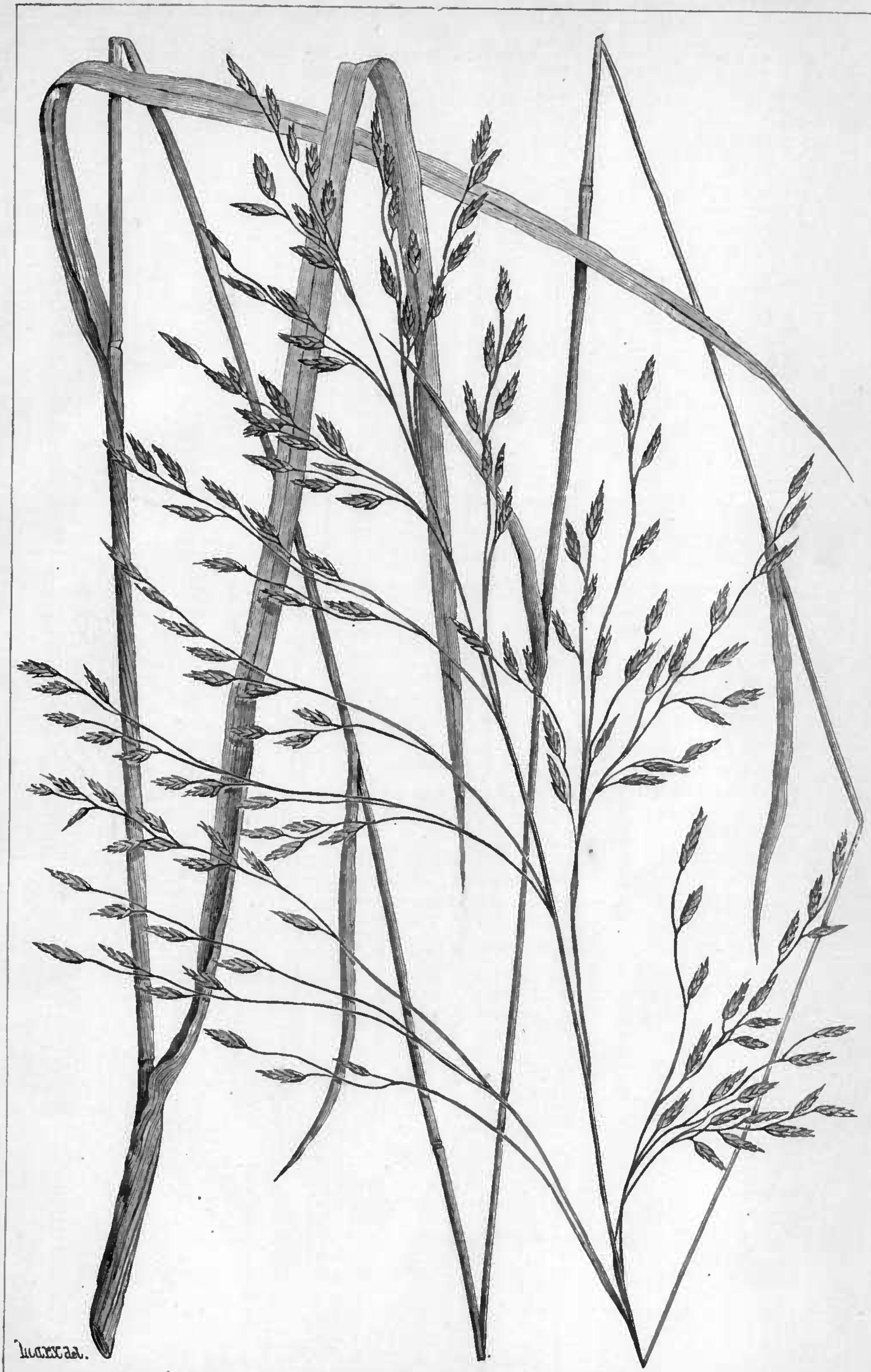
Description.—This grass grows from 3 to 5 feet high. It is very smooth; the leaves are long and flat, the lower sheaths hairy or smoothish. The panicle is large and loose, at first erect, but finally spreading widely; the branches in pairs or single, naked below, flowering toward the extremities and becoming drooping. The spikelets are 5 to 6 flowered, 3 to 4 lines long, purple, on short pedicels. The glumes are shorter than the flowers, unequal, and pointed; the lower palet is hairy toward the base, having 3 strong nerves which are extended into short cusps or teeth at the summit. It is a large and showy grass when fully matured, the panicles being large, spreading, and of a handsome purplish color. Instead of being called Tall Red-top it would be much more properly called Purple-top.

Habit and uses.—It grows in sandy fields and on dry, sterile banks, from New York to South Carolina, westward to the prairies, and southwestward to Texas, where several other species also occur.

J. S. Gould, in the Report of the New York State Agricultural Society, says it is not considered very valuable, but it is nevertheless cut for hay and eaten by cattle where it abounds naturally, as in the mountain meadows of Pennsylvania. It is, however, harsh and wiry, and probably would not be eaten by cattle that could have access to better. (See Plate 18.)

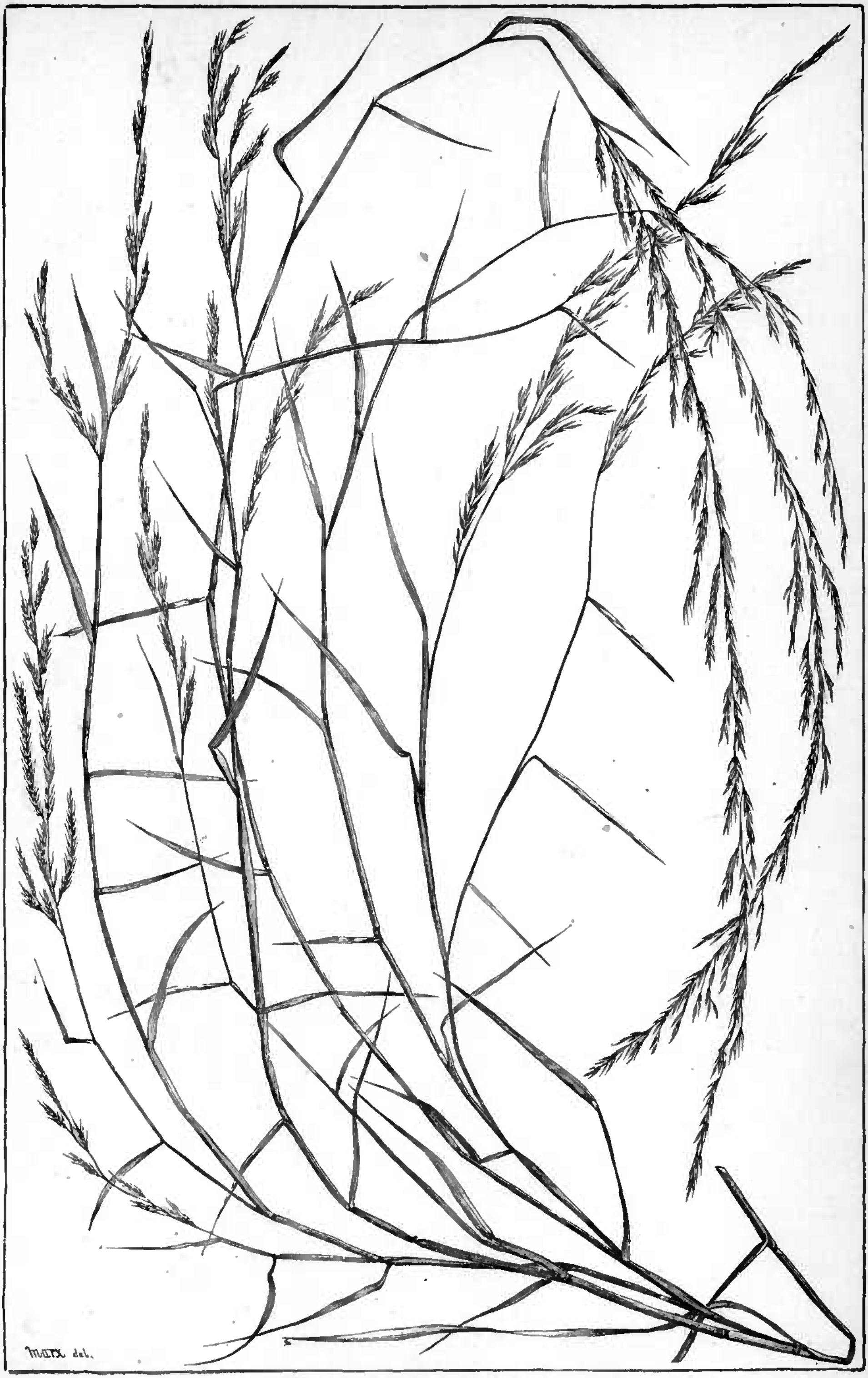
Proximate analysis of Tricuspis seslerioides, from Texas (Tall Red-top).

	Per cent.
Oil	1.81
Wax	.24
Sugars	6.98
Gum and dextrin	3.16
Cellulose	37.86
Amylaceous cellulose	26.45
Alkali extract	12.63
Albuminoids	6.32
Ash	4.55
	100.00



TRICUSPIS SESLEROIDES.

PASPALUM LÆVE.



MUHLENBERGIA DIFFUSA.

Analysis of ash of Tricuspis seslerioides (Tall Red-top).

	Per cent.
Potassium	8.13
Potassium oxide	38.49
Sodium	----
Sodium oxide	----
Calcium oxide	2.32
Magnesium oxide	.53
Sulphuric acid	4.04
Phosphoric acid	1.58
Silicic acid	37.52
Chlorine	7.39
	100.00

PASPALUM LÆVE—Water grass.

Description.—There are a number of species of this genus which in general appearance are hardly distinguishable. In the structure of the flowers they are very near to Panicum, from which they chiefly differ in the want of a lower glume. The flowers are spiked or racemed in two or more rows on one side of a flattened rachis or stalk The spikelets are one-flowered or with the rudiment of a second. The flowers are ovate or roundish, the palets thick and tough, flat on the inner and convex on the outer side.

Uses.—Mr. D. L. Phares, of Mississippi, says of this grass:

It is not called water grass because it grows in and about water, for it does not, but probably because it is very succulent. It is troublesome in crops; live stock are very fond of it in all stages of growth and as dry hay. A neighbor has a meadow of it from which he mows every summer about two tons of hay per acre. It is very easy to set land with it. (See Plate 19.)

Proximate analysis of Paspalum læve, from Texas (Water grass).

	Per cent.
Oil	1.74
Wax	1.02
Sugars	8.86
Gum and dextrin	5.47
Cellulose	27.72
Amylaceous cellulose	26.67
Alkali extract	13.95
Albuminoids	8.14
Ash	6.43
	100.00

Analysis of ash of Paspalum læve (Water grass).

	Per cent.
Potassium	----
Potassium oxide	25.44
Sodium	1.12
Sodium oxide	.60
Calcium oxide	9.36
Magnesium oxide	5.26
Sulphuric acid	5.64
Phosphoric acid	6.18
Silicic acid	44.65
Chlorine	1.73
	100.00

MUHLENBERGIA DIFFUSA—Drop-seed, Nimble Will.

Description.—This is a low grass, with much-branched stems and narrow, slender panicles of flowers. The spikelets are one-flowered, with very minute glumes, and the lower palet with an awn or beard once or

twice its own length. It is a perennial grass, flowering in August and September. Professor Killebrew, of Tennessee, says:

It is hardly more than necessary to mention this grass, which forms, in many sections, the bulk of the pastures of the woods. It does not grow in fields but in woods, where, after rains have set in, it carpets the earth with living green.

Uses.—Various opinions are entertained as to its nutritive qualities. Some farmers contend that their stock are fond of it, and, on sufficient range, cattle, horses, and sheep will go into the winter sleek and fat from this vigorous grass. Others regard it as well-nigh worthless. It is said to be an excellent butter-making grass, and gives a particularly fine flavor to this article of food." (See Plate 20.)

Proximate analysis of Muhlenbergia diffusa, from Texas (Drop-seed grass, Nimble Will)

	Per cent.
Oil	1.39
Wax	.43
Sugars	8.96
Gum and dextrin	4.48
Cellulose	23.37
Amylaceous cellulose	19.81
Alkali extract	23.89
Albuminoids	10.06
Ash	7.61
	100.00

Analysis of ash of Muhlenbergia diffusa (Drop-seed grass, Nimble Will).

	Per cent.
Potassium	6.78
Potassium oxide	17.32
Sodium	1.33
Sodium oxide	......
Calcium oxide	11.95
Magnesium oxide	4.39
Sulphuric acid	3.39
Phosphoric acid	6.65
Silicic acid	39.98
Chlorine	8.21
	100.00

LEPTOCHLOA MUCRONATA—Feather grass.

Description.—An annual grass, growing from 2 to 3 feet high, the flowers arranged on numerous slender spikes in a long panicled raceme. The flowers are minute, 3 to 4 in a spikelet, the uppermost one imperfect; the glumes pointed and about equaling the awnless flowers. This is a handsome grass when full grown, the panicles on thrifty specimens sometimes becoming 2 feet long, the slender branches arranged along the main stem in a feather-like manner, hence the name.

Uses.—Professor Killebrew says that it grows in fields and pastures and affords a small amount of grazing during the hot months, while the regular pasture grasses are parched up with heat. But it is of no agricultural value in the presence of so many others that are successfully grown. (See Plate 21.)

Proximate analysis of Leptochloa mucronata, from Texas (Feather grass).

	Per cent.
Oil	1.68
Wax	.40
Sugars	7.[illegible]3
Gum and dextrin	6.[illegible]
Cellulose	32.16

LEPTOCHLOA MUCRONATA.

SETARIA SETOSA.

UNIOLA LATIFOLIA.

	Per cent.
Amylaceous cellulose	23.69
Alkali extract	11.55
Albuminoids	7.80
Ash	8.98
	100.00

Analysis of ash of Leptochloa mucronata (Feather grass).

	Per cent.
Potassium	1.81
Potasssium oxide	20.21
Sodium	.80
Sodium oxide	----
Calcium oxide	5.94
Magnesium oxide	2.66
Sulphuric acid	3.31
Phosphoric acid	6.46
Silicic acid	55.92
Chlorine	2.89
	100.00

SETARIA SETOSA—Pigeon grass, Bristle grass.

Description.—There are two species of *Setaria* or Pigeon grass which are very common in cultivated fields in the Northern States, springing up after the cutting of grain, and often yielding a fair crop for the scythe. In some of the Southern States, and particularly in Texas, there is another species, the one above named, which is of larger and stronger growth.

Uses.—Its habit is much like that of Italian millet, which is *Setaria Italica*, and its use and value is probably much the same as that species. We have no definite information as to the extent to which this grass is diffused. (See Plate 22.)

Proximate Analysis of Setaria setosa, from Texas (Pigeon grass, Bristle grass).

	Per cent.
Oil	1.05
Wax	.46
Sugars	9.25
Gum and dextrin	5.15
Cellulose	32.76
Amylaceous cellulose	26.41
Alkali extract	9.60
Albuminoids	8.61
Ash	6.71
	100.00

Analysis of ash of Setaria setosa (Pigeon grass, Brittle grass).

	Per cent.
Potassium	----
Potassium oxide	39.33
Sodium	2.47
Sodium oxide	1.18
Calcium oxide	2.31
Magnesium oxide	1.56
Sulphuric acid	3.51
Phosphoric acid	3.24
Silicic acid	42.59
Chlorine	3.81
	100.00

UNIOLA LATIFOLIA—Wild Fescue.

This is a handsome grass, with larger spikelets than any other we have mentioned; in form they are somewhat like those of Bromus unioloides, and like them are very flat and compressed.

Mr. Chas. Mohr, Mobile, Ala., who sends specimens, says:

A fine vernal grass, with a rich foliage, blooming early in May; 2 to 3 feet high; frequent in damp, sandy loam, forming large tufts. This perennial grass is certainly valuable, affording an abundant range early in the season; if cultivated it would yield large crops ready for cutting from the 1st of May. It is called by some wild fescue or oat grass. It is not found near the coast, consequently I had no chance to observe its growth during the latter part of the summer and in the winter season, and therefore am not able to judge of its value as a pasture grass.

It grows as far north as Pennsylvania, but it is less vigorous in growth as it advances northward. (See Plate 23.)

Proximate analysis of Uniola latifolia, from Alabama, (Wild fescue.)

	Per cent.
Oil Wax	3.23
Sugar	6.78
Gum and dextrine	4.02
Cellulose	38.67
Amyl cellulose	10.23
Alkali extract	14.40
Albumenioids	11.29
Ash	11.38
	100.00

Analysis of ash.

	Per cent.
Potassium oxide	5.52
Potassium	5.19
Magnesium oxide	3.02
Calcium oxide	7.15
Phosphoric acid	4.92
Sulphuric acid	2,62
Chlorine	4.71
Silica	66.87
	100.00

FORAGE PLANTS.

LESPEDEZA STRIATA—Japan clover.

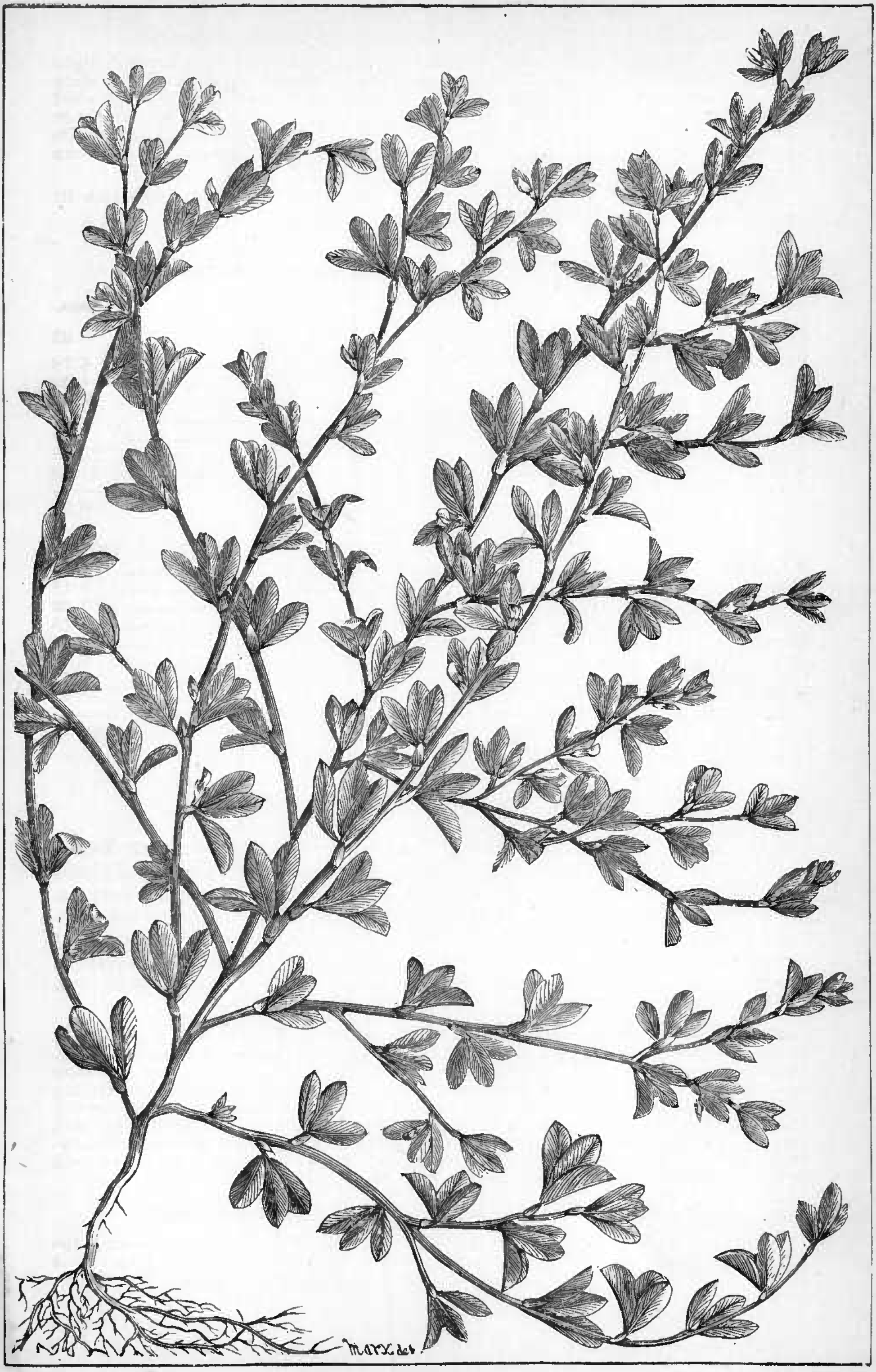
Description.—Much has been said and written in the Southern States concerning this recent immigrant from Japan. It is a low perennial plant, not rising much above the ground, but spreading widely on the surface. It belongs to the leguminous family of plants, which includes the common clover, bean, pea, &c. The leaves are very small, trifoliate, and very numerous. The flowers are exceedingly small and produced in the axils between the leaf and stem, and the fruit is a small flattish pod.

History and uses.—Professor Killebrew says concerning it:

About the year 1849 it was noticed in the vicinity of Charleston, S. C., the seeds having probably been brought from China or Japan in tea boxes. A short time afterwards it was discovered at a distance of forty miles from Charleston, and still later near Macon, Ga. It seems especially adapted to the Southern States, not flourishing above 36°, growing with great luxuriance on the poorest soils and retaining vitality in its roots in the severest droughts. It is said to be a fine plant for grazing, and, being perrennial, needs no resowing and but little attention. On soils unfit for anything else it furnishes good pasturage and supplies a heavy green crop for turning under and improving the land.

Mr. Samuel McRamsey, of Warren County, Tennessee, says:

This clover made its appearance in that locality in 1870. It is fast covering the whole country; it supplies much grazing from the first of August until frost. It is short, but very hard. Sheep are very fond of it, and cattle will eat it.



LESPEDEZA STRIATA.

Mr. Charles Mohr, Mobile, says:

Introduced from Eastern Asia, it has, during the last decade, overspread the Southern States from the Atlantic slope to the banks of the Mississippi. Cattle and horses are eating it. Of its value as a nutritive food I cannot speak. (See Plate 24.)

Proximate analysis of Lespedeza striata, from Alabama (Japan clover).

	Per cent.
Oil	3.30
Wax	1.10
Sugars	14.74
Gum and dextrin	6.76
Cellulose	23.77
Amylaceous cellulose	14.67
Alkali extracts	16.22
Albuminoids	15.11
Ash	4.33
	100.00

Analysis of ash of Lespedeza striata (Japan clover).

	Per cent.
Potassium	4.67
Potassium oxide	34.78
Sodium	----
Sodium oxide	----
Calcium oxide	29.60
Magnesium oxide	4.75
Sulphuric acid	7.82
Phosphoric acid	7.54
Silicic acid	6.61
Chlorine	4.23
	100.00

DESMODIUM—Tick-seed, Beggar-lice.

Description.—Several species of these plants have, during a few years past, been exciting attention in the South for their availability as forage plants, and for plowing under to enrich the soil. They are slender, spreading, annual, bushy plants, of the natural family Leguminosæ, growing usually in open woods and fence-rows, and are well known from the tendency of the hispid, or rough seed-pods, to adhere to the clothing of animals and of passers-by.

Proximate analysis of Desmodium, from South Carolina (Tick-seed, Beggar-ticks).

	Per cent.
Oil	2.35
Wax	.44
Sugars	13.46
Gum and dextrin	8.15
Cellulose	25.39
Amylaceous cellulose	14.39
Alkali extract	7.04
Albuminoids	21.22
Ash	7.56
	100.00

Analysis of ash of Desmodium (Tick-seed, Beggar-ticks).

	Per cent.
Potassium	6.33
Potassium oxide	27.81
Sodium	.56
Sodium oxide	----
Calcium oxide	23.42
Magnesium oxide	7.11
Sulphuric acid	5.10
Phosphoric acid	11.87
Silicic acid	11.19
Chlorine	6.61
	100.00

DESMODIUM.

Besides the analyses of the grasses, an analysis has been made of this plant, to the results of which especial attention is called.

By reference to the analysis it will be at once seen how large an amount of albuminoids is present, and for the purpose of comparison the analysis of red clover is placed below with that of this plant.

	Desmodium.	Red clover.
	Per cent.	Per cent.
Carbohydrates	45.83	41.0
Albuminoids	21.22	16.1
Cellulose	25.39	35.1
Ash	7.56	7.8
	100.00	100.00

For convenience of comparison the carbohydrates are grouped together. It will be seen that the albuminoids of the Desmodium are to those in red clover as 132 to 100, while the amount of ash varies but slightly in the two plants. The immense value of clover as a crop preparatory to other crops, especially wheat, is well known, and there is perhaps no way by which exhausted lands may be more readily restored to fertility, and maintained in such condition, than by the use of clover; certainly there is no method which compares with it in expense. Now, although clover requires an amount of plant food, both mineral and atmospheric, far in excess of a wheat crop, nevertheless it is a fact very well established that the former crop may be successfully grown upon a field where wheat would invariably fail of a good crop.

The reasons for this are to be seen in a comparison of the two plants; and, although it is a "thrice told tale," the importance of the subject, especially in connection with this plant under consideration, is such that every farmer should practically understand the matter.

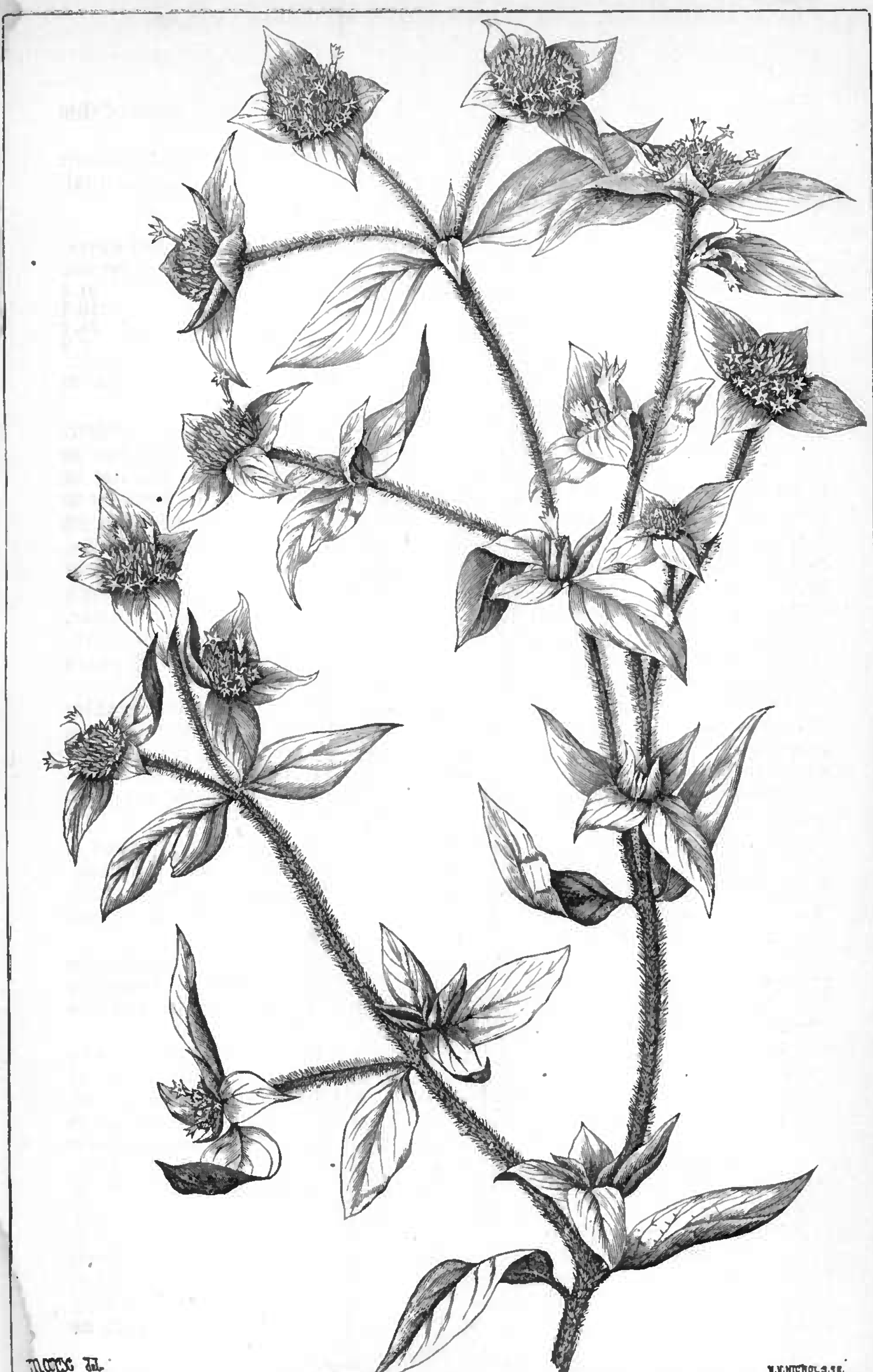
Clover and wheat, then, belong to two families of plants, which in nearly every respect are in the strongest contrast.

Clover is one of the dicotyledonous plants, or those of which the seed is divided into halves, as with the pea, bean, &c. These plants are characterized also by a strong tap-root, which, descending into the subsoil, enables the plant to secure nourishment from sources beyond the reach of plants of the other sort.

Wheat, on the contrary, belongs to the monocotyledonous plants, the seeds of which are not so divided in halves, as Indian corn for example. The roots of this family of plants are surface or crown roots, and are destitute of the tap-root already spoken of.

Again, if we consider the habits of growth of the two plants, we have in clover a plant of continuous growth throughout the season until cut down by frost or the scythe of the mower, and an enormous leaf development, as compared with wheat with its scant leafage and its short life. We have, then, in clover a plant with a tap-root and an enormous root development, enabling it to seek out and assimilate mineral food, with great extent of leaf surface, fitting it to take in and assimilate atmospheric food; a long period of growth, which causes it to appropriate the greatest amount of both kinds of food and store them up in root and stem. In wheat, on the other hand, we have a surface-rooted plant, a scanty leafage, and a short period of growth. What wonder, then, that so coarse a feeder as clover should thrive, even where so dainty a plant as wheat should utterly fail, as is so often the case? But, as

Plate XXV.



RICHARDSONIA SCABRA.

will be remembered, all this atmospheric and mineral food, which has been assimilated and stored up in the roots and stems of clover remains to furnish an abundant supply, by its decay, to the crop which shall succeed it, and thus clover or similar plants have always played a most important part in all systems of rotation, as in the wheat-growing region of the Genesee Valley of New York. In this Desmodium we have a plant which appears to be a substitute for clover and to possess this great advantage, viz: that it will flourish vigorously upon certain lands upon which a crop of clover cannot be secured. This seems to be especially true of the sand barrens of the Atlantic seaboard. Certainly if the statements made concerning it are to be credited, it is destined to effect a revolution in agriculture throughout this section, and to restore to fertility lands which have been practically abandoned by the farmer.

RICHARDSONIA SCABRA—Mexican clover.

This is an annual plant of the Natural Order Rubiaceæ, which contains the coffee, cinchona, and ipecacuanha plants. It is a native of Mexico and South America, and has within a few years become extensively naturalized in some parts of the South. Under favorable circumstances it grows rapidly, with succulent, spreading, leafy stems, which bear the small flowers in heads or clusters at the ends of the branches and in the axils of the leaves. The flowers are funnel-form, white, about half an inch long, with 4 to 6 narrow lobes, and an equal number of stamens inserted on the inside of the corolla tube. The stem is somewhat hairy, the leaves opposite, and, like other plants of this order, connected at the base by stipules or sheaths. The leaves are oblong or elliptical and one or two inches long. Mr. John M. McGehee, Milton, Fla., writes as follows:

I send you a small sample of what we here call Florida Clover, others call it Water Parsley, and others Bell Fountain. This plant is now attracting more interest in this section than any other article of farming interest. It is very troublesome to farmers in the cultivation of their crops; its growth is very rapid. It contains a great deal of water, and is hard to cure as a hay. Some call it very good hay, others say it is worthless. For the last 50 years it has been regarded as a great pest to farmers. It is now coming into notice as an element in green-soiling, which has never been practiced in this section before.

Mr. Matt. Coleman, Leesburg, Sumter County, Florida, writes as follows:

I inclose a specimen of a plant called Spanish Clover. The tradition is that when the Spanish evacuated Pensacola this plant was discovered there by the cavalry horses feeding upon it eagerly. Five years ago, hearing of it, I procured some of the seed and have been planting or cultivating it in my orange grove from that time to the present as a forage plant and vegetable fertilizer. I find it ample and sufficient. It grows on thin pine land from four to six feet, branches and spreads in every direction, forming a thick matting and shade to the earth, and affords all the mulching my trees require. One hand can mow as much in one day as a horse will eat in a year; two days' sun will cure it ready for housing or stacking, and it makes a sweet, pleasant-flavored hay; horses and cattle both relish it. The bloom is white, always open in the morning and closed in the evening. Bees and all kinds of butterflies suck the bloom.

This plant was brought to the attention of the department in 1874, and samples for analysis were sent from Mobile by Mr. Chas. Mohr and by Dr. J. F. B. Rohmer. Mr. Mohr's account of it and the chemical analysis made by Dr. McMurtrie were published in the annual report for that year. Mr. Chas. Mohr recently says of this plant:

Along the seaboard of this State the so-called Mexican Clover is found spreading extensively; it covers the sandy upland soils completely with its prostrate, succulent,

leafy stems, bearing the small white funnel-form flowers in terminal heads and axillary whorls. In regard to its nutritive value, it is scarcely inferior to clover; horses, cattle, and sheep are fond of it, particularly of the hay. As a green manure it is of the greatest benefit to the farmer in the lower pine region.

In addition to its value as a fodder plant it is believed to have much medicinal value. In Jamaica it furnishes what is called white ipecac, which has been used as a substitute for the genuine ipecac.

Dr. Rohmer, of Spring Hill College, near Mobile, sent specimens of the roots for analysis in 1874, but they were, unfortunately, lost. Dr. Rohmer says:

I was the first discoverer of the plant in Blakely, Baldwin County, Alabama, in 1858. When the war broke out I was appointed by the confederate government botanist for the department of the gulf, for the purpose of having such medicinal plants collected as in my judgment might be rendered useful in the treatment of disease, and subsequently I received the appointment of superintendent of a laboratory established at Mobile for the manufacture of medicinal preparations for the use of the army. The idea suggested itself to me that the Richardsonia might be made to supersede the commercial ipecac, instead of using the euphorbia corollata, as has been suggested. In the fall of 1863 I had the roots collected, dried, and powdered, and then delivered to the medical purveyor. From the testimony of surgeons, the Richardsonia answered every purpose when given in increased doses.

It is designed to obtain a supply of the roots the coming season and have them analyzed with reference to the presence of emetine. (See Plate 25.)

P. S.—Material for analysis of this plant was not received in season to be used in this report.

Proximate analyses of grasses.

Name.	Oil.	Wax.	Sugars.	Gum and dextrin.	Cellulose.	Amylaceous cellulose.	Alkali extract.	Albumen.	Ash.
Desmodium, Beggar-lice	2.35	.44	13.46	8.15	25.39	14.39	7.04	21.22	7.56
Lespedeza striata, Japanese clover	3.30	1.10	14.74	6.76	23.77	14.67	16.22	15.11	4.33
Hierochloa borealis, Vanilla grass	3.75	.37	12.71	5.42	23.30	23.15	8.58	14.31	8.41
Eleusine Indica, Wire grass	1.78	.38	11.92	6.33	31.29	25.46	......	13.72	9.12
Do	1.72	.35	13.29	5.84	22.38	26.37	10.44	13.28	6.33
Do	2.27	.29	8.69	4.98	21.53	21.97	20.97	12.23	7.07
Uniola latifolia, Fescue grass	3.23*	......	6.78	4.02	38.67	10.23*	14.40*	11.29	11.38
Cynodon dactylon, Bermuda grass	1.86	.36	6.56	9.29	24.55	27.43	12.64	11.15	6.16
Do	1.23	.36	8.17	3.59	23.57	29.30	12.23	13.59	7.9[illegible]
Sporobolus Indicus, Smut grass	2.99	.31	8.17	2.75	25.91	27.06	14.16	12.46	6.19
Andropogon Virg., Broom grass	1.24	.47	7.98	5.02	33.73	26.32	5.80	13.00	6.44
Andropogon scoparius	1.16	.43	5.37	3.44	24.91	26.51	28.07	6.21	3.90
Poa pratensis, Ken. Blue grass	1.82	1.04	9.61	3.14	27.94	22.53	17.20	11.54	5.18
Poa serotina, Fowl Meadow grass	1.95	1.53	9.33	7.49	25.62	25.24	15.19	8.91	4.74
Dactylotenium Ægypt., Egyptian grass	1.64	.32	10.96	5.60	17.48	31.63	16.46	9.01	6.90
Panicum sanguinale, Crab grass	2.87	.02	9.88	5.60	32.80	24.29	3.87	9.99	10.68
Panicum jumentorum, True Guinea grass	1.27	.31	5.93	4.51	31.76	16.30	22.60	8.95	8.37
Panicum obtusum	1.77	.50	9.68	5.74	33.32	24.21	8.75	7.28	8.75
Panicum virgatum, Tall Panic grass	1.25	.45	7.05	3.37	37.38	27.59	13.06	5.01	4.84
Do	1.75	.17	9.61	3.02	28.87	25.94	22.50	4.58	3.56
Panicum Texanum, Texas Millet	1.98	.56	12.49	5.98	27.68	20.64	18.43	5.61	6.63
Panicum crusgalli, Barn-yard grass	1.54	.57	13.87	5.07	32.27	21.37	11.03	4.14	10.14
Panicum filiforme, Slender Crab grass	1.29	.25	5.89	4.67	26.78	29.96	23.19	3.32	4.65
Sorghum halapense, Johnson grass	2.25	.61	7.37	5.14	25.15	25.87	15.58	13.18	4.85
Sorghum avenaceum, Indian grass	1.57	.10	7.27	3.75	36.70	27.25	14.44	3.29	5.63
Muhlenbergia diffusa, Drop-seed	1.39	.43	8.96	4.48	23.37	19.81	23.89	10.06	7.61
Bromus unioloides, Schrader's grass	2.99	.24	14.36	1.00	24.31	23.74	13.13	12.45	7.78
Bromus carinatus, Brome grass	2.46	.24	9.38	4.56	26.90	17.02	19.15	9.98	10.31
Agrostis exarata, Brown-top	2.12	.19	7.06	8.95	24.59	24.62	16.20	10.65	5.62
Paspalum læve, Water grass	1.74	1.02	8.86	5.47	27.72	26.67	13.95	8.14	6.43
Setaria setosa, Bristly Fox-tail	1.05	.46	9.25	5.15	32.76	26.41	9.60	8.61	6.71
Leptochloa mucronata, Feather grass	1.68	.40	7.33	6.41	32.16	23.69	11.55	7.80	8.98
Tripsacum dactyloides, Gama grass	1.72	.68	8.84	3.66	26.59	20.84	23.09	8.62	5.96
Tricuspis seslerioides, Tall Red-top	1.81	.24	6.98	3.16	37.86	26.45	12.63	6.32	4.55
Average	1.92	.46	9.42	5.08	27.89	24.08	15.05	9.81	6.74

* The analysis of *Uniola latifolia* is not comparable throughout with the other analyses. In this case the wax was not separated from the oil, but both were calculated to one amount (3.23 per cent.); also the alkali extract was made previous to making the sulphuric acid extract (amylaceous cellulose), the reverse of this order being taken with the other grasses. Because of these variations the above averages are computed independently of this analysis.

Ash analyses—Grasses.

Name.	Potassium, K.	Pot. Oxide, K_2O.	Sodium, Na.	Sod. Oxide, Na_2O.	Calcium oxide, Ca O.	Magnesium oxide, Mg O.	Sulphuric acid, SO_3.	Phosphoric acid, P_2O_5.	Silica, SiO_2.	Chlorine, Cl.
Desmodium, Beggar-lice	6.33	27.81	.56	......	23.42	7.11	5.10	11.87	11.19	6.61
Lespedeza striata, Japanese clover	4.67	34.78	......	......	29.60	4.75	7.82	7.54	6.61	4.23
Hierochloa borealis, Vanilla grass	4.54	31.51	.25	......	3.97	2.54	2.55	7.42	42.73	4.49
Eleusine Indica, Wire grass	9.52	10.27	1.26	......	10.27	4.10	4.24	2.69	47.56	10.09
Do	7.39	24.79	......	......	13.65	7.38	5.79	9.68	24.61	6.71
Do	4.55	30.98	3.55	......	11.10	5.57	8.55	9.84	16.25	9.61
Uniola latifolia, Fescue grass	5.19	5.52	......	......	7.15	3.02	2.62	4.92	66.87	4.71
Cynodon dactylon, Bermuda grass	6.66	22.99	......	......	13.44	5.00	9.37	6.20	30.29	6.05
Do	9.61	22.89	.42	......	7.99	2.96	11.31	5.09	30.27	9.46
Sporobolus Indicus, Smut grass	12.16	33.53	......	......	2.64	2.66	4.60	6.02	27.36	11.03
Andropogon Virg., Broom grass	7.01	13.93	......	......	6.76	1.83	2.80	2.97	58.33	6.37
Andropogon scoparius?	15.70	......	......	......	2.12	.58	Trace	1.33	64.62	15.65
Poa pratensis, Ken. Blue grass	6.95	33.81	......	......	4.81	3.23	4.76	9.88	30.25	6.30
Poa serotina, Fowl Meadow grass	2.79	31.71	.83	......	6.70	2.92	3.35	10.80	37.10	3.80
Dactylotenium Ægypt., Egptian grass	7.50	21.20	......	......	20.67	6.91	4.42	8.37	24.17	6.76
Panicum sanguinale, Crab grass	6.67	33.56	......	......	4.40	7.98	4.02	6.40	30.93	6.04
Panicum jumentorum, True Guinea grass	8.57	35.93	......	......	10.18	14.16	2.51	4.37	16.51	7.77
Panicum obtusum	4.62	21.65	......	......	5.91	3.13	6.71	5.18	48.60	4.20
Panicum virgatum, Tall Panic grass	3.36	18.76	1.22	......	7.87	3.63	3.56	5.50	51.17	4.93
Panicum maximum?	1.54	22.53	1.74	......	7.39	7.98	5.29	4.37	45.10	4.06
Panicum Texanum, Texas Millet	4.54	27.95	1.58	......	7.39	4.57	4.63	8.48	34.31	6.55
Panicum crusgalli, Barn-yard grass	12.00	13.26	.37	......	7.23	5.52	3.69	4.27	42.18	11.48
Panicum filiforme, Slender Crab grass	13.41	12.98	......	......	4.69	5.18	4.84	6.37	40.36	12.17
Sorghum halapense, Johnson grass	3.68	35.72	.81	......	12.87	6.73	2.96	10.44	22.21	4.58
Sorghum avenaceum, Indian grass	6.74	16.84	......	......	2.92	1.36	2.13	2.35	61.56	6.11
Muhlenbergia diffusa, Drop-seed	6.78	17.32	1.33	......	11.95	4.39	3.39	6.65	39.98	8.21
Bromus unioloides, Schrader's grass	16.38	37.20	1.27	......	4.43	4.64	5.61	8.79	4.84	16.84
Bromus carinatus, Brome grass	......	31.61	2.98	2.17	6.19	2.19	3.94	9.29	38.33	3.30
Agrostis exarata, Brown top	3.97	38.41	......	......	5.61	3.84	1.93	8.01	34.63	3.60
Paspalum læve, Water grass	......	25.44	1.12	.60	9.36	5.26	5.64	6.18	44.65	1.73
Setaria setosa, Bristly Fox-tail	......	39.33	2.47	1.18	2.31	1.56	3.51	3.24	42.59	3.81
Leptochloa mucronata, Feather grass	1.81	20.21	.80	......	5.94	2.66	3.31	6.46	55.92	2.89
Tripsacum dactyloides, Gama grass	6.30	29.06	4.77	......	1.64	1.07	3.69	2.52	37.87	13.08
Tricuspis seslerioides, Tall Red-top	8.13	38.49	......	......	2.32	.53	4.04	1.58	37.52	7.39
Average	7.13	26.76	......	......	8.42	4.36	4.69	6.37	35.78	7.15

NOTE.—Traces of iron were present in each of the above, and in some the amount was quite appreciable, but not determined. Traces of manganese were present in Dactylotenium Ægyptiacum, Hierochloa borealis, and Bromus carinatus, and in the first mentioned grass Mu_3O_4 constituted 2 per cent. of the crude ash. The above averages are computed independently of the analysis of ***Uniola latifolia***.

NUTRITION OF PLANTS AND ANIMALS.

In order that the general reader may be the better able to understand the results of the foregoing analyses of the grasses, cereals, and other nutritive materials, a few words upon the general subject of vegetable and animal nutrition seem desirable, and will, doubtless, prove acceptable.

Through the action mainly of the sun's rays the plant is able to take up those simple chemical compounds present in the atmosphere and the earth, *e. g.*, carbonic acid, water, ammonia, phosphoric acid, sulphuric acid, nitric acid, potash, lime, magnesia, and a few others, and from these simple compounds elaborate other compounds far more complex in their chemical composition, *e. g.*, sugar, oil, starch, cellulose, vegetable albumen, and all the countless proximate constituents which chemical analysis has shown to exist in the vegetable world, as for example the essential oils and the vegetable alkaloids and acids.

Unlike the vegetable, the animal is quite unable to assimilate and elaborate these simple compounds into the complex ones which make up the animal organism, but is forced to depend for its supplies of food

wholly upon the vegetable world, either directly, as do the herbivora, or indirectly, like the carnivora.

If now we consider the function of food, we shall see that it is four-fold in the young animal, viz., to supply the means of growth, to repair waste tissue, to maintain animal heat, and to supply muscular force; while in the adult animal the last three functions exist.

The tissue of the animal is mainly bone and muscle. The bone is composed almost entirely of phosphate of lime and a compound rich in nitrogen. The muscle is composed mainly of fibrin, which is also a nitrogenous compound, that is, an organic compound containing nitrogen, resembling in composition vegetable albumen.

Fat, on the other hand, is a compound which contains no nitrogen, but is composed of carbon, hydrogen, and oxygen.

Since, then, the animal is unable to elaborate for itself these compounds, it is obvious that to provide for the growth and development of bone and muscle there is need that a portion of the food should consist of such vegetables as may be able to furnish these nitrogenous compounds. Furthermore, since, like any other machine, there is constantly going on a certain amount of "wear and tear," so to speak, of the machine, there is needed, even in the adult animal, a certain amount of these same nitrogenous compounds to repair this continual waste of tissue.

When we come, however, to consider the other functions of food, viz., the maintenance of animal heat and the supplying of muscular force, it has, during the past few years, been pretty conclusively established that these functions may be performed quite as effectively by non-nitrogenous food, as for example starch, fat, and sugar, compounds composed only of carbon, hydrogen, and oxygen, as by nitrogenous food.

In the production of fat also, since this is a compound containing no nitrogen, it is elaborated from non-nitrogenous food, but nevertheless its ready production appears to be dependent upon the presence to a certain extent of nitrogenous food in the diet.

By reference now to the several analyses given of grasses and cereals, the following constituents are given in their composition: Oil, wax, sugar, gum, dextrin, starch, soluble starch, amylaceous cellulose, alkaline extract, and cellulose. The above-mentioned compounds are composed wholly of carbon, hydrogen, and oxygen. There are given also the following: Albumen soluble, albumen insoluble, and zein. These three last mentioned are compounds rich in nitrogen, but containing also carbon, hydrogen, and oxygen.

It remains yet to consider the relative nutritive value of these several compounds. There exists a strong analogy between the vegetable and animal in this—that very much depends upon the condition of the food which is presented as to its capability of being assimilated by the plant or animal.

For example, although plants require a certain amount of potash and of phosphoric acid for their development, it has been conclusively proven that if the former be presented firmly locked up in chemical combination, as in feldspar, it is practically unavailable to the plant. So, too, if phosphoric acid be introduced into the soil in the form of a very difficultly soluble phosphate, as powdered, apatite, that no good results follow from such application. So, too, leather chips, though rich in nitrogen, will for years withhold this important element from the plant, which, although adjacent to such supply, suffers from its inability to appropriate it.

In like manner, with reference to animal food, the real nutritive value of food depends rather upon the ability of the animal to digest and as-

similate it, than upon the chemical composition of such food. To illustrate: Cellulose and starch have absolutely the same percentage composition of carbon, hydrogen, and oxygen; but while the value of starch as food is universally conceded, the worthlessness of cellulose is as universally admitted. The reason is that starch when taken into the stomach is readily digested and taken into the blood, while cellulose resists any such chemical change and is eliminated from the body unchanged.

Those constituents of animal food which are composed of carbon, hydrogen and oxygen only are known under the general name of carbohydrates, but there is great difference between these as to their relative nutritive value. Some of them are readily digested, as starch and the sugars, while others are apparently incapable of digestion, as cellulose. Still others of these compounds appear to have a certain value, which at the present is not well defined nor generally accepted. Among these constituents are gum, the so-called amylaceous cellulose, and the alkaline extracts of the foregoing analyses.

As to gum, certain experiments appear to show that it is capable of digestion—at least some kinds of gum. It is at least true that in the laboratory it is found subject to changes closely analogous to those of starch, that is, it may be converted into one of the sugars. So, too, of the compound given in the analyses as amylaceous or starchy cellulose. This substance appears to stand in its chemical properties, as its name implies, midway between starch and cellulose. Although not so readily acted upon as starch, it is yet far more readily affected than cellulose; and since in the digestive apparatus of the herbivora it is subject to action somewhat analogous to those conditions which effect its conversion into sugar in the laboratory, it seems not unlikely that such changes do ensue during the process of digestion, and that this compound possesses a nutritive value not far inferior to true starch.

The compound present in the grasses and given under the name of alkaline extract is still more obscure, and its nutritive value as yet not established. In composition it is closely analogous to the starchy compounds; and since by mild chemical reagents it is proved to enter into solution, it appears not improbable that it possesses a nutritive value not far removed from the well-known members of the group of carbohydrates to which it belongs, viz., starch and sugars.

As will be seen, then, there yet remains, even in the consideration of our best known grains and grasses, a wide field for further investigation; and although the results of chemical analysis seem to indicate the results which practical experiments in feeding shall establish, these practical results remain undetermined.

METHOD OF ANALYSIS OF GRASSES.

1. *Estimation of water.*—Three grams of the finely powdered grass were dried as rapidly as possible at a temperature of 105°–110° C. The loss of weight was taken as water.

2. *Estimation of oil and wax.*—The previously dried three grams of grass were extracted with ether, sp. gr. .722, in the apparatus figured in Proceedings Am. Chem. Soc., Vol. 2, No. 2, p. 85, which, with some modifications, seems to be admirably adapted for this work. The ether was carefully evaporated at a low heat, and the residue weighed as oil and wax. This residue was then extracted with cold ether and the portion undissolved estimated as wax.

3. *Estimation of sugars, &c.*—The residual grass from treatment with ether was percolated with warm 85 per cent. alcohol untill 200 c. c. were

passed through. Of this liquid an aliquot portion was evaporated in a platinum dish and weighed, the residue ignited and again weighed, the difference being organic matter ash-free. This residue contained besides sugars traces of tannin, more or less coloring matter, possibly alkaloids, resins, salts of organic acids, and occasionally nitrates and ammonium salts.

4. *Estimation of gum and dextrin.*—The residual grass after extraction with ether and alcohol was extracted with 250 c. c. of boiling water. The ash-free residue was determined in an aliquot part. The amounts of gum and dextrin were nearly equal in most cases, although their perfect separation and estimation was not thought desirable.

5. *Estimation of cellulose.*—Two grams of the coarsely powdered grass were digested with 150 c. c. of Powers & Weightman's solution of chlorinated soda until perfectly bleached. The liquid was removed by filtration through fine linen, and the crude cellulose was boiled for two hours with 150 c. c. of a 1¼ per cent. solution of potassic hydrate. The undissolved cellulose was gathered on a linen filter and thoroughly washed, by aid of Bunsen filter pump, with water, alcohol, and finally with ether. The residue was transferred to a platinum crucible and dried at 120–130° C. until a constant weight was obtained. The nitrogenous matter was estimated in one portion of the so purified cellulose, and the ash in another portion, and the slight deductions for these impurities being made, the remainder was estimated as pure cellulose. It had none of the characteristics of the so-called *amylaceous cellulose*, to be described further on, it being very slightly acted upon by hot dilute acids and alkalies.

6. *Estimation of albuminoids.*—One-half gram of the finely powdered grass was ignited in a combustion tube with excess of dry soda-lime. The evolved ammonia was received in freshly standardized decinormal oxalic acid, and the amount neutralized was determined by titration with decinormal alkali. The nitrogen so found was multiplied by 6.25 for total albumen. Duplicate estimations were made in every instance.

7. *Estimation of amylaceous cellulose.*—After the treatment of the powdered grass with ether, alcohol, and boiling water, as already described, the remaining grass was boiled for two hours with 100 c. c. of 2 per cent. sulphuric acid. The liquid was filtered from the undecomposed grass, neutralized with barium carbonate, again filtered, and the residue well washed with hot water. An aliquot portion of the filtrate was evaporated on the water-bath, weighed, ignited, again weighed, and the residue stated as organic matter. This residue was very soluble in cold water, and was a mixture of dextrine with a little glucose. It is believed to have been formed from cellulose by action of the hot dilute acid, as the amount of starch in the grasses was shown by microscopic examination to be very slight. It seems highly probable that the part of the cellulose which was so readily converted into dextrine and glucose may have existed in the plant in some modified, possibly immature, form. Certainly, the purified cellulose when treated in the same manner is much less rapidly acted upon by hot dilute acid, an experiment showing that it lost only about 6 per cent. by treatment for two hours with 200 c. c. of 2 per cent. sulphuric acid. It seems also probable that the cellulose which is so readily acted upon by chemical agents may be easily digested, and possesses a food value approaching, if not equal to, that of starch and the sugars. If this is proven, it will be seen that properly cured grasses are but little inferior as flesh formers, or as food in its broader meaning, to the cereals. Nor is this conclusion greatly at variance with the generally accepted views of advanced agriculturists,

with many of whom *hay*, as it was formerly prepared, has become quite obsolete, and they insist upon *dried grass* as the name to be hereafter used and the material to be hereafter provided as a winter supply of food to their animals. It is certainly noticeable that within the past fifteen years there has been a gradual tendency among farmers to cut their grass at earlier periods in its growth and development, long experience having taught them that the nutritive value of their supply of hay was by no means correctly estimated by its weight or bulk; and there is little doubt but that this later practice, which experience sanctions, will be fully sustained by the results of chemical analysis and the teachings of science. Indeed, in the few analyses of native grasses already given there will be found strong confirmatory proof of the position assumed, for by reference to the two analyses of Andropogons (Virginicus and scoparius, closely allied varieties of the same species) there will be seen a marked difference in the results, the amount of albuminoids in the first being to those present in the second as 100 : 48. The probable explanation of this discrepancy is to be found in the fact that the former specimen was taken at an earlier stage of growth. It follows also that to be of greatest value the analyses of all the above grasses should be duplicated from specimens taken at periods of development even earlier than that at which these samples were taken, since it is well known as a fact that cattle will feed with avidity upon certain grasses at one season of their development, for which at a later season of growth they manifest no desire.

The specimens of grasses analyzed were taken mainly at the time when the development of the flower or seed rendered their identification certain, but it is altogether doubtful whether this period of development was in every case that of maximum nutritive value. A careful series of feeding experiments would doubtless throw much light upon this subject, and enable us to fix more accurately the actual and relative nutritive value of our grasses.

In reference to this prominent constituent of all the grasses, which for want of a better name has been termed Amylaceous Cellulose, there certainly is need of experimental results from feeding. It has been pretty generally thought that it was only the cellulose of the tender and more succulent plants which was capable of digestion and assimilation, but certain later experiments throw doubt upon these earlier conclusions. Voit has shown (Chem. Central Blat., 1870, page 223) that while such crude fiber was not digested by the carnivora, on the contrary, herbivorous animals digested 50 per cent. or more; and according to the experiments of Weiske (Chem. Central Blat., 1870, page 531, and 1872, page 409) swine, like the herbivora, digest over 50 per cent. of this crude fiber.

In a paper entitled "Chemical Investigations into the Composition of Wood," published in Kolbe's Jour. Prak. Chem. Band 19, p. 146, Th. Thomsen, of Copenhagen, enters upon a discussion of the above question. He experimented upon this substance, extracted from wood by a solution of sodic hydrate, after previously exhausting the wood with ether, alcohol, water, and ammonia.

Payan in 1839 had already shown that fiber obtained after treatment with the above neutral solvents contained 54 per cent. of carbon, while pure cellulose from cotton or pith contained only 44 per cent. This variation was attributed to a so-called incrusting substance, which, according to Schulze's method with HNO_3 could be removed.

Some chemists, however, considered this incrusting substance as a mixture of several substances; while others, as Schulze (1857) and Erdmann (Annal. Chem. & Pharm., Suppl. B and p. 223, 1867), gave it a for-

mula as a pure body, and called the fiber which had been obtained by extraction of wood by these neutral solvents and acetic acid *glycolignose.*

Thomsen considers all previous experiments to have failed hitherto because of using too powerful reagents for extraction, whereby the substances treated suffered partial decomposition.

He treated birch wood with soda lye at common temperatures, and easily extracted a substance which was reprecipitated by dilute acids. Pine wood, on the other hand, contained almost none of this substance.

Poumerède and Figuier, in 1847 (Jour. Pharm., 12, 81; Jour. für Prak. Chem., 42, 25; Annalen, 64, 387), are the only persons who have pursued this investigation, and they obtained from poplar and beech, by such treatment, a substance free from nitrogen, and having the composition of cellulose, and possessing, as they said, the properties of pectin or pectic acid.

Now, this "pectin substance" is what Thomsen has investigated, and he finds it to be isomeric with cellulose. He finds this substance to be most abundant in the birch and ash; then alder, cherry, oak, pear, beech, elm, willow, horsechestnut, and maple; while almost none was found in the pine, the amount varying from 20 per cent. in birch to less than 1 per cent. in pine. It occurs more abundantly in heart-wood than in the exterior of the tree. According to his method of preparation it is a white powder, insoluble in water at ordinary temperatures, but upon boiling it with a large quantity of water it gives a clear solution, which becomes opalescent upon cooling, but clears up upon addition of sodium hydrate. Its solution has an acid reaction, and upon evaporation it leaves a transparent, gum-like mass. He proposes to call this substance *wood gum*—"Holzgummi."

It appears, then, not improbable that between the extremes of starch and the sugars upon the one hand, and pure cellulose upon the other, there may exist many intermediate links in the condition of compounds isomeric with the one or the other, and readily passing in the processes of vegetable life from one form to another—compounds which have hitherto escaped searching investigation, and which may indeed defy any attempts at their isolation, but which, nevertheless, may not be safely ignored in our estimations as to the nutritive value of the different grasses.

It certainly seems somewhat remarkable that so little has been done since those experiments of Poumerède and Figuier to either confirm or overthrow their conclusions.

After treating the grasses with dilute sulphuric acid, as has been described in the determination of the so-called amylaceous cellulose, the grass was boiled for two hours with a 2 per cent. solution of sodic hydrate. This treatment removed considerable matter, part of which could be precipitated by excess of sulphuric or hydrochloric acid. This flocculent precipitate was dark colored, and undoubtedly contained a part of the albuminoids of the grass; but the greater portion had the physical appearances and solubilities of the humous substances of the older authors, or the wood gum, "Holzgummi," of Thomsen. As will be seen in the analyses of the several grasses and in the proximate analyses of various vegetable products in this report, this substance invariably appears. It is not improbable that it adds greatly to the food value of the plant; but whether it is originally present in the plant, or is a decomposition product formed by action of dilute acids and alkalies upon cellulose, seems not to be definitely settled.

Regarding Thomsen's Holzgummi from beech wood as a definite substance, and taking into consideration the fact that from our alkali ex-

tract a substance was precipitable by acids similar in external appearance to the Holzgummi, it seemed of interest to determine whether, by following the exact treatment described by Thomsen, the same substance could be isolated from the grasses. Experiments in a qualitative way with *Sorghum nutans* and *Bromus unioloides*, showed that the very same Holzgummi is contained in the grasses that Thomsen found in the various woods. Although the precipitate from our original alkali extract was very dark colored owing to various albuminoid and coloring matters, the precipitate of Holzgummi from the soda extract after previous treatment with strong ammonia was quite colorless, and possessed all the properties and showed all the reactions of Thomsen's substance. As the Holzgummi is therefore not peculiar to wood the name seems inappropriate, and our previous designation of the group as amylaceous cellulose is for the present, at least, more desirable.

The fact that sodic hydrate in 2 per cent. solution is able to extract this definite substance from grasses led to an inquiry as to what effect 2 per cent. sulphuric acid would have after such treatment. Would it extract by conversion to dextrin and glucose as much matter as in the earlier application of the reagent, or would it extract only enough to make the total of the two extracts, sodic hydrate and sulphuric acid, alike in each instance, the crude fiber remaining always constant? From experiments the latter seems to be the case, as may be seen from the following results obtained with the sorghum and bromus mentioned above:

Sorghum nutans gave, when treated first with 2 per cent. sulphuric acid, 27.25 per cent. of extractive matter, and on subsequent treatment with sodic hydrate, 14.44 per cent., a total of 41.69 per cent. When this treatment was reversed and sodic hydrate used first the extracts were, (1) sodic hydrate, 35.00; (2) sulphuric acid 5.24 per cent.; a total of 40.24. *Bromus unioloides* gave similar results, and the two may be tabulated as follows:

Sorghum nutans.

	Per cent.		Per cent.
First extraction with sulphuric acid	27.25	First extraction with sodic hydrate	35.00
Second extraction with sodic hydrate	14.44	Second extraction with sulphuric acid	5.24
Total extracted matter	41.69	Total extracted matter	40.24

Bromus unioloides.

First extraction with sulphuric acid	23.74	First extraction with sodic hydrate	34.12
Second extraction with sodic hydrate	13.13	Second extraction with sulphuric acid	4.34
Total extracted matter	36.87	Total extracted matter	38.46

It is seen that by either method the total amount extracted remains very nearly constant, but that there is a substance which can be extracted by either sodic hydrate or sulphuric acid. What this substance is, of course, is not definitely known; but as sodic hydrate gives us the extractive in a form certainly nearer its original structure, the treatment of the grass with that reagent before the application of 2 per cent. sulphuric acid seems to be advisable in future grass analyses, and in fact in the analyses of any plant where the presence of starch in quantity does not require removal by acid.

ANALYSIS OF THE ASH.

For the ash analysis about 30 grams of the air-dry and coarsely cut grass were charred at a heat below redness, an unavoidable glow in

some cases passing through the mass and leaving the ash nearly free from carbon.

The crude ash was treated with water on the water bath, and afterwards with dilute HNO_3, the two solutions being mixed and made to a definite bulk.

The residue insoluble in HNO_3, consisting of coal, sand, and most of the silica, was ignited to remove the carbon, and the SiO_2 was separated from the sand by concentrated solution of $NaOH$.

One third (*a*) of the solution being set apart for a determination of Cl and SO_3, the rest was evaporated to dryness, to separate the SiO_2 soluble in HNO_3, in many cases this being sufficient to gelatinize the liquid as it became concentrated.

After separation of this SiO_2, the solution was divided in halves—(*b*) and (*c*)—each representing thirds of the original solution. In the first third (*a*), from which the Cl had not been removed by evaporation with HNO_3, a standard solution of $AgNO_3$ gave the amount of Cl, and after removal of the excess of Ag, SO_3 was determined as usual.

In another third (*b*) P_2O_5, CaO, and MgO were determined, P_2O_5 being separated by $NaC_2H_3O_2$, and Fe_2Cl_6 as basic phosphate dissolved in HCl, and, after addition of excess of $C_4H_6O_6$, precipitated as PO_4MgNH_4. In the filtrate from the basic phosphate CaC_2O_4 is precipitated as usual, ignited and dissolved in HCl. After evaporation to dryness and addition of a few drops of NH_4OH to remove any Fe_2Cl_6 present, the $CaCl_2$ is fused and the Cl determined volumetrically. From this the CaO is calculated. In the filtrate from CaC_2O_4 the Mg was determined as usual.

In the third portion (*c*) oxalic acid was added in crystals and the solution warmed on the water bath till no more nitrous fumes were evolved, then evaporated to dryness and heated on the sand bath till the excess of oxalic acid was driven off, the heat being toward the end increased to convert all the oxalates to carbonates. This removes most of the lime and magnesia on filtration. To the filtrate baric hydrate is added to remove any magnesia and phosphoric acid which may remain. The excess of barium is removed by ammonic carbonate and the alkalies remain as carbonates in the filtrate, and hydrochloric acid is added to convert the carbonates to chlorides, which are gently heated, and if any carbon is present the solution is refiltered. In the mixed chlorides the chlorine was determined volumetrically and also gravimetrically, and the proportions of Na and K were calculated by the indirect method.

From the sum of all substances determined the per cent. of pure ash in the grass was calculated.

The percentage composition of the ash was reckoned to unity in the usual manner.

GLOSSARY OF TERMS USED IN DESCRIBING GRASSES.

Acuminate—Extending into a long, tapering point.
Acute—Sharp-pointed.
Annual—Living through one season only.
Anther—The upper part of the stamen containing the pollen or fertilizing powder.
Awn—A bristle-like process proceeding from or attached to the glumes or palets of some grasses.
Biennial—Living through two seasons.
Boat-shaped—Concave within and convex without, as the glumes and palets of some flowers.

Bristles—Short, stiff hairs.
Bulbous—The base of the stem thickened so as to make a hard, roundish mass, as in Timothy grass (*Phleum pratense*).
Cæspitose—Growing in bunches or tufts.
Cauline—Relating to or growing from the stem or culm.
Ciliate—Having the margin fringed with hairs.
Culm—The stem or straw of a grass; when the stem creeps upon or under the ground it is called a *rhizoma*.
Decumbent—Leaning on the ground at the lower part but rising at the top.
Digitate—Branching finger-like from a common center, as the spikes of Crab-grass (*Panicum sanguinale*).
Diœcious—The two sexes separated and growing on different plants, as in Buffalo grass (*Buchloë dactyloides*).
Entire—Without notches on the margin.
Exserted—Protruded beyond the flower, as the stamens of grasses usually are when in bloom.
Fertile—Producing fruit.
Fibrous—Composed of thread-like fibers, as the roots of most grasses.
Floret—A little flower; a pair of palets with the inclosed stamens and pistil. There may be many of these in a spikelet.
Glabrous—Smooth; destitute of hairs or roughness.
Glumes—The outer or lower pair of bracts or scales in a spikelet, and inclosing one or more, sometimes many, flowers or florets.
Hirsute—Rough-haired, bearded.
Indigenous—Growing naturally in a country.
Internode—The space between the nodes or joints.
Keel—A sharp ridge along the middle of a glume or palet resembling the keel of a boat.
Lamina or Blade—The extended part of a leaf, generally open and flat, but sometimes rolled inward longitudinally, when it is said to be *involute*.
Ligule—A small leaf-like appendage, usually thin and semi-transparent (membranaceous), found at the lower part of the leaf or at the top of the sheath. It is said to be *entire* when there are no divisions in its outline; *bifid*, when it is divided at the apex into two parts; *lacerated*, when it is cut or divided on the margin; *truncated*, when the upper part terminates abruptly in a transverse line, as if cut off.
Membranaceous—Thin and translucent, like a membrane.
Nerves—Rib-like elevations on the leaves, glumes, and palets.
Neutral flower—One having neither stamens nor pistil.
Nodes—Knots in the culm where the leaves are given off.
Oblong—Longer than wide, with the sides nearly parallel.
Obtuse—Blunt pointed.
Ovary—The portion of a flower containing the ovules or seeds.
Palet or Palea—The inner scales or bracts inclosing the stamens and pistil.
Panicle—The flowering part of the stem or culm of grasses, usually composed of a number of series or whorls of branches or rays, which are again divided into secondary branches. These may be short and close to the stem, or they may be long and spreading.
Perennial—Living for more than two years; indefinitely.
Pistil—The central organ of a fertile flower, usually consisting of an ovary, style, and stigma.
Pollen—The fertilizing powder contained in the anthers.

Pubescent—Covered with soft hairs.

Rachis—The name given to that kind of flowering branch where the flowers are arranged closely together on its sides without stalks or pedicils, as in Paspalum, and in the ultimate branches of the panicle.

Radical leaves—Those growing from the root.

Spikelet—The ultimate divisions of the panicles or flower-heads; they may be *one-flowered*, that is, a pair of glumes enveloping a single flower of a pair of palets (or sometimes one palet) with the inclosed stamens and pistil; or they my be *two* or *more flowered*, there being but one pair of glumes to each spikelet, whether it be one or many flowered.

Sheath—That part of the leaf which clasps the stem; it answers to the petiole or leaf-stalk.

Spike—When the flowers are sessile or without branches, as in Timothy grass (*Phleum pratense*).

Stamens—The organs of the flower which contain the pollen, consisting of the filament and the anthers.

Stigma—The extremity of the pistil which receives the pollen.

Whorl—A number of leaves or branches starting from one line on the stem.

GEO. VASEY,
Botanist.
PETER COLLIER,
Chemist.

HON. WM. G. LE DUC,
Commissioner of Agriculture.

REPORT OF THE SUPERINTENDENT OF GARDENS AND GROUNDS.

SIR: I have the honor to submit the following report upon matters pertaining to the duties of this division:

RAISING TEA-PLANTS.

In raising plants of the Chinese tea from seed it is recommended, in treatises on the culture of this plant, to carefully shade the young plants from the direct rays of the sun, and this is evidently an essential point. The seeds if kept dry after ripening, soon shrink and become loose in the shell, but, when in this condition, if they are sown in moderately damp soil they swell, become plump, and germinate in a short time. When sown in boxes and placed in the damp atmosphere of a greenhouse, the glass being slightly shaded, the seeds germinate in about four weeks after sowing, and the young plants grow rapidly, requiring no particular care, except that they are not kept too damp previous to germination. But when sown in drills in the open ground, the points of the young growths dry up as soon as they reach the surface and become exposed to direct sunlight. It is therefore necessary to choose a shaded position for sowing the seeds, or, if it is not practicable to secure such a location, a thin sprinkling of short hay spread over the surface immediately after sowing the seeds will be found advantageous, allowing the young plants to push up through the covering.

Liberian Coffee Plant.

ARABIAN COFFEE PLANT.

The recent importations of tea seeds from Japan have arrived in good condition. These were simply packed in bulk in close cases. An importation of Assam tea seeds from the East Indies which were packed in sawdust were found, when the case was opened, to be completely enveloped with a fungous growth which had destroyed their germinative properties.

COFFEE.

The Liberian coffee proves to be more tender, and to require a higher temperature for its profitable culture than the common or Arabian coffee. The Liberian plant is of a larger growth, the foliage heavier and very distinct; individual leaves measure from 10 to 12 inches in length and from 4 to 6 inches in width, while those of the common Arabian coffee, under similar conditions of growth, measure from 5 to 6 inches in length and about 3 inches in width. The berry of the Liberian species is proportionately large, but objections are made in regard to its introduction in South America on account of the size of the plant, as being less amenable to culture and the gathering of the crop. The quality of the beverage it furnishes is not inferior to that of the common coffee, and the plants are very productive. The proportion of pulp and parchment inclosing the bean is larger than in that of the Arabian coffee. The proportion of worthless covering to bean is nearly as 4 to 1 in the Liberian, while it is said not to attain 2 to 1 in the African.

JAPAN PERSIMMON.

Referring to the hardiness of the Japan persimmon, it was stated in a former report that there was quite a difference in this respect among seedling plants, some remaining uninjured during the severest winters here, while others suffered to the extent of being killed to the ground. Since the date of that report several importations of grafted plants have been received directly from Japan. This collection includes ten named varieties. A number of plants of each variety have been planted here for the purpose of testing their hardiness, and the result shows that there is a like difference in this respect among the grafted kinds that had previously been found among the plants raised from seed. Some of the varieties have been entirely destroyed, while the remaining sorts have not been injured, even in a slight degree, and are in perfect health. How far north of this locality these plants may be grown will be a matter for further experiment.

Up to this time the Department has not recommended the planting of these trees in the Northern States, but it would appear that there is so much difference in their hardiness as to warrant the supposition that they may succeed in colder climates than was at one time considered probable. This much is certain, that the hardier varieties have stood uninjured, when in a young state, an amount of cold several degrees below zero.

FIGS.

The culture of figs has never attracted much attention in the Middle and Northern States owing to the susceptibility of the plants to cold. They are perfectly adapted to the climates of the Southern States, where they have long been cultivated for domestic purposes, but not produced in sufficient quantities to be included among commercial products.

The fig may be fruited in sheltered localities in the Northern States by taking the precaution of covering the branches during winter, so as

to protect them from severe freezing. This is not difficult to accomplish, the most simple and effectual method being that of bending down the branches, and fastening them as close to the ground as practicable, in which condition they can readily be covered with 8 or 10 inches of soil, or an equally thorough coating of forest leaves protected by a covering of boards to exclude rain.

The fig bears most satisfactorily when it is planted in gravelly or sandy soils; in strong rich soils, luxuriant growths are produced, and the young fruit will drop prematurely; the wood will also ripen imperfectly, and thus diminish the number of perfect fruit-buds. After the fruit makes its appearance, and all during its progress toward ripening, the plants require an abundance of water; if the roots are kept dry at any time during this period the fruit will probably drop; but when the fruit becomes soft, indicating ripeness, a less supply of water will improve its flavor, and further tend to harden and ripen the annual growths of the tree.

THE APRICOT.

Inquiries have been made as to the value of the apricot as a fruit and its culture as an orchard tree.

Although the apricot is one of the most delicious of stone fruits, and ripens earlier than the peach, yet it is a scarce fruit in our markets and is rarely seen on the dessert table. This may be accounted for by any one or all of the following reasons: First, the tree is easily excited to growth in spring, and a week or two of mild weather will start the flower buds, which are afterwards destroyed by cold or frosty weather. This is a very common occurrence north, and even south, of the Potomac, and may be measurably modified by planting on the north side of buildings or groves of trees, and thus retard the starting of the buds, and shield them from the morning sun after a cold night. Then, when the fruit is set, a second trouble is encountered in the attacks of the curculio, which punctures the fruit of the apricot with a regularity similar to that with which it addresses the plum. Unless measures are taken to check the ravages of this insect the crop will certainly be destroyed, and probably the most decidedly effectual method of checking its progress and propagation is that of planting the trees in an inclosure where poultry and hogs are allowed to run at large. Good crops of plums are secured under these circumstances, the animals destroying the grubs as they occur in the fallen fruit.

The third and greatest drawback to apricot culture is the liability of the trees to loss of branches by a blight somewhat similar to that which destroys the pear tree. The earliest history of apricot culture makes mention of this malady; branches will suddenly wither and die without any apparent cause, and so fatal does it become that orchards of considerable extent have rapidly become extinct from this fatality, for which no effectual remedy has yet been discovered.

NATIVE GRAPES.

It is very generally conceded that the culture of native grapes is not so promising a remunerative industry as could be desired. New varieties, some of them possessing merit, are still being announced, but there is no improvement in their adaptability to general culture in ordinary localities. It was formerly the custom to compare the grape zone, as it was called, to that of Indian corn; which was intended to convey the idea that where this crop would mature, the native grape would also

reach maturity. So far as heat and cold are involved in temperatures, this criterion is probably nearly correct, the amount of heat necessary to insure a crop of corn being also sufficient to mature most of the varieties of cultivated grapes which have been derived from our native northern species, but the numerous failures in profitable grape culture prove that other factors besides those of heat and cold have an important influence upon the health of a vineyard.

To those who are conversant with the history of the progress of grape culture in the United States for the past thirty years, and have acquainted themselves with the causes of varying failures and successes, it must seem difficult to account for the fact that grape growers in general have been slow, and apparently unwilling, to recognize the true reason for most of the failures which occur. In some of the earliest reports of the Department of Agriculture the statement was dwelt upon that the greatest obstacle to complete success in grape culture could be referred to the deterioration of the plants consequent upon the injury they sustained from mildew on the leaves. This explanation of failure was not generally considered as conclusive. Both grape growers and authors of treatises on grape culture, especially the latter, usually referred failures to some other cause or causes, which were expressed by the phrase "improper treatment," and this was considered a sufficient answer to all inquiries regarding failures.

This profound explanation was generally accompanied by the further advice that by giving vineyards "proper treatment" they would be exempt from failure or loss. When called upon to define "improper" and "proper" treatment, the answers would be often contradictory, and more frequently unsatisfactory. This want of recognition of the true source of trouble has been greatly against progressive grape culture. Varieties of grapes much lauded for their superior qualities have been procured at great expense and extensively planted, the result only adding another disappointment to the planter. The main cause of failure has been frequently pointed out, and from time to time the department has published lists of those varieties best adapted to general culture, as also those which require special localities, and further experience has borne conclusive evidence of the value and accuracy of these reports. It was distinctly shown, and it is now clearly admitted, that the distinguishing feature of a good grape climate is that where there is an entire absence of mildew on the foliage or on the fruit of the vines. While making this statement somewhat prominent it is not forgotten that heavy losses are occasioned by rot in the berry. This disease is not, however, confined to varieties subject to leaf mildew, but it is equally prevalent in those which are rarely attacked by it. The causes of mildew are solely atmospheric, while those favoring rot are more intimately connected with the chemical and physical condition of the soil and the growth by the roots. We need no stronger proof of the influence that the presence or absence of mildew on the leaves of our native grapes has upon the determination of their value, than to turn to the list of the varieties which are most extensively cultivated, when it will be found that they are valued more because of their freedom from disease than from the qualities of their fruit.

Again, it is clearly ascertained that the most fatal species of mildew is caused by dampness, so that the further statement may be made that where we find a locality in which grapes are specially remunerative, we will find that its climate is characterized by the absence of heavy dews. It is only in these latter localities and under their special conditions that the best varieties afford a profitable return. Where heavy dews prevail during the summer months it has been found unsatisfactory to cultivate

such varieties as the Iona, Walter, Eumelan, Diana, Croton, Delaware, Catawba, and others of first excellence. Partial success may sometimes be attained, owing to local conditions of protection and shelter; and, as has long ago been thoroughly demonstrated and reported, all these varieties can be grown to perfection when they are protected from heavy dews, either by artificial or natural expedients, such as those of covering the trellis upon which they are tied by a canopy of boards, canvas, or glass, or by allowing the vines to grow up in trees whose foliage will protect that of the vine.

But little further progress can be attained in the culture of the grape, either for table use or for the manufacture of wine, until a distinction is practically recognized between the species and their varieties which are severally best suited for these respective purposes. In Europe, where all the cultivated grapes are said to have been produced from one species, the varieties are numerous, but they are divided into distinct classes, based upon their values as regards suitableness for wine, for table use, or for drying into raisins.

In the United States we have several distinct native species, from one or other of which have been originated all the varieties now in cultivation. The only classification of these which has been presented looking to the arrangement of varieties under the species from which they have been produced, will be found at page 81 of the Report of the Department of Agriculture for the year 1869. An attempt was there made to draw attention to the most valuable peculiarities of the different species, peculiarities which are more or less inherited by the varieties which have originated from them, as also the climates to which they seemed best adapted. Since then some attention has been given to the significance and importance of the points embraced in that classification, but the subject is still unrecognized by the majority of those engaged in grape culture.

The idea that our native grapes would be more rapidly improved by securing hybrid kinds between them and the foreign species has long been entertained; and, although it has constantly been argued by some that no good result could thus be obtained, yet of late years much attention has been directed to this mode of improvement, and, as was to be expected, varieties of very superior merits have been produced, many of them equal to the best of the foreign varieties, in flavor as well as in appearance, but no variety so produced has yet proved able to maintain itself as worthy of general cultivation; in fact, they are altogether unreliable except under conditions where even the foreign grape can be raised with a good degree of success. This is much to be regretted, but it is nevertheless the truth that nothing of value and reliability has by this means been added to our list of hardy grapes, and all experience, so far, in this direction only tends to prove the wisdom of the advice given many years ago that the line of improvement should be confined to hybridizing our native species with each other, and by selection ultimately procure varieties of reputed merit both for table use and for the manufacture of wines. But this improvement cannot be systematically pursued unless accompanied by a very distinct and clear understanding of the respective merits of American species.

Until quite recently, varieties of the fox grape, *Vitis labrusca*, have mostly been produced, and these have been recommended and cultivated both for wine and table use, and but little attention has been given to the improvement of other species, notwithstanding that the summer grape, *Vitis æstivalis*, and its varieties have vastly superior merits as wine grapes. No better evidence of this fact need be desired than the

estimate given to these wines in foreign countries. Most of the American wines which have been specially recognized at foreign expositions have been the products of this class of grapes. But the ultimate value of these grapes will not be realized until vineyards of them are established in localities where they can be ripened. They require a longer warm season than suffices for varieties of the *labrusca* family; consequently they are not successfully grown in localities where the improved fox grapes are most largely cultivated, and for that reason the summer grapes are but little known; and in the localities where they may be produced in perfection the culture of wine grapes has not yet become an established industry.

Among the best-known varieties of this eminently wine-producing species may be mentioned the Lenoir, Herbemont, Devereaux, Alvey, Cynthiana, and Norton's Virginia Seedling. These varieties yield wines of very high excellence and of varied qualities. But they can only be grown to perfection in certain elevated locations in the States of North Carolina, Virginia, and other States having similar climates.

It therefore appears probable that in the further improvement of hardy grapes these peculiarities of species, and the purposes for which they are best adapted, must receive more attention than has hitherto been given to them.

FOREIGN GRAPES.

For the past two or three years the crop of fruit in the grapery has been more or less injured by a leaf-hopper insect, which is usually, but I believe erroneously, called "thrips." These insects destroy the vitality of the leaves, causing them to become crisp and shriveled and to fall prematurely. They increase rapidly, fly off in clouds when the leaves are disturbed, and are difficult to subdue. The usual remedy for the destruction of this notable pest is to fumigate the structure with tobacco smoke; but in a large house it is no easy task to effectually destroy these insects by this means, as they drop down and find shelter under pathways, &c., and become lively when the smoke has dispersed. Nightly fumigations continued for a week at a time only partially diminished their numbers, even when supplemented by daily syringings with water in which tobacco had been steeped. Finding this remedy ineffectual, without bestowing more time to it than the labor force of this division would warrant, it was resolved to try the effects of sprinkling the leaves with water in which quassia chips had been steeped. One pound of these chips, tied loosely in a bag, was placed in a barrel of water and allowed to stand for 48 hours. Before using it 50 per cent. of pure water was added to the decoction, which then tasted exceedingly bitter. The vines were syringed daily with this mixture, and it has been found a much more effectual remedy than the former one of tobacco, and the insects have been kept fairly under subjection, although they have not been completely eradicated, and they increased to some extent after the quassia application had to be discontinued so as not to taste the fruit. A few applications of clean water should be given to remove all bitterness from the bunches.

It is well known that the main reason for cultivating the foreign grape under glass in this climate is on account of mildew. In former reports it has been shown that judicious care in ventilation, combined with a sufficiency of atmospheric humidity, will prevent the attacks of fungoid growths on the foliage of the vines. Practically, this treatment, so as to insure the entire prevention of mildew, is not always readily maintained. Occasionally it will happen that the temperature of the

house has reached a higher degree than is quite desirable before ventilation can be given, and when the ventilators are opened a sudden lowering of the temperature takes place. Such rapid changes are specially provocative of mildew, which will be found to make its appearance upon the leaves contiguous to the opening. When these conditions occur—and they are unavoidable in ordinary management—the temperature can be lowered several degrees by sprinkling the plants and floor of the house with water, after which the ventilation may be given gradually; the moisture in the air will tend to modify any injurious effects from the ingress of the cooler external air. These sudden changes of temperature are a certain cause of mildew on young, tender leaves. Their effects are frequently seen on the leaves of peach trees in early summer, causing them to blister and producing the appearance commonly called "curl" in the leaves, and which is frequently, but erroneously, supposed to be caused by the *aphis*, which is sometimes, but not always, present.

Rose-growers know that the utmost care in ventilation will not always enable them to prevent the young leaves of roses from attacks of mildew. In all such cases a saturated atmosphere is beneficial.

ROTATION IN CROPPING.

It may be surmised that the necessity for rotation of crops soon became apparent to the earlier cultivators. They would discover that their best efforts in appliances were unavailable in maintaining a continuous profitable growth of the same kind of plant on the same soil. When soils became unproductive it was supposed that the land required rest, hence the practice of fallowing was introduced. Fallowing was a common practice among the Romans. It was their usual course to allow the land to rest after each crop—a crop and a year's fallow succeeding each other. Where manure was applied two crops were taken, and on some lands several crops were taken between the fallowing periods. It was a very natural deduction that the land required rest when observation showed that after successive crops of the same plant, it refused to grow, although the land had not apparently diminished in fertility.

The agriculture of the ancient Egyptians being confined to the banks and lowlands adjacent to rivers, where from annual overflows a rich deposit of mud and sand was left on the surface, which formed an annual layer of fresh material, did not include the process of fallowing or resting lands, because constant fertility was maintained by the annual top-dressing which was left by the receding waters.

The practice of resting and fallowing soils, or that of changing the crops more or less systematically, has always been found to be advantageous, although the reasons for its necessity have not been satisfactorily explained.

Various theories have been offered by physiologists explanatory of the principles upon which the benefits of rotative cropping depends. Modern chemistry has shown that plants require certain mineral substances for their support, and that although the same primary elements may be found in all, yet they are found to be in very different proportions in different kinds, some showing a mere trace of a substance which may abound in others. These mineral matters being obtained from the soil, it follows that if they are not present in sufficient quantities or do not exist in a sufficiently soluble state so as to be taken up by the roots, the plant which demands them for its normal growth must suffer in consequence of such deficiency; and in regard to specific inorganic substances, it is evident that the plant which requires a large percentage of such would

fail to succeed where another plant requiring only a trace of the substance would maintain a healthy growth. Some plants require much potash or soda, some much lime, others a large proportion of silica. A rotation which would allow these plants to follow each other in succession, or cause one crop which requires only a small quantity of any particular inorganic substance to succeed another which requires that substance in large amount, would consequently be beneficial.

Taking these facts as a basis, the theory is propounded that the necessity for a rotation of crops is caused by the exhaustion of certain inorganic substances which, if supplied in due quantities, would insure the successful growth of the same plant on the same soil for an indefinite period. But in the absence of the knowledge indispensably necessary for an accurate estimate of the exact quantities required, a system of rotation is not only advisable but it is the only resource of the cultivator until science determines the exact specific relations which exist between the plant and the soil from whence it receives its food.

The deductions naturally following the above explanation regarding plant food led to the supposition that chemical analysis would indicate, with a great degree of certainty, the exact line of practice to be followed in regard to rotation of crops, or perhaps obviate the necessity for any change except that of convenience. This was to be effected by analyzing the soil and the plant to be grown in it, so that the ingredients removed by the latter could be replaced, and thus the fertility of the soil indefinitely maintained. But at present there are no indications that such accurate knowledge is forthcoming, neither the analyses of soils nor the analyses of plants furnishing the data seemingly necessary for practical purposes.

The phenomena attending the growth of certain crops for a series of years on the same soil apparently includes certain factors that are not readily explained. For instance, it is observed that even in the case of such humble plants as the petunia and the verbena, if they are continued for a few years in the same ground they will cease to give satisfaction, even although the soil is annually manured with ground bones, rotted stable manure, or other kinds of ordinary manurial applications. In flower gardens, when it is desired to grow these plants year after year in the same spot, it is found necessary to renew the soil yearly by removing 6 or 8 inches from the surface and replacing it by fresh earth from other sources.

The same results have been found in the culture of the grape. For a number of years past it has been customary for the department to propagate several thousands of plants, embracing many varieties, of native grapes. These are mostly grown from *single eye* cuttings in sand beds under glass, and placed singly in pots when rooted. About the end of May they are turned out of the pots, and planted out in the open field rather closely, in rows which are about three feet apart. When they have finished growth for the season they are lifted and removed from the field; the ground receives a coating of rotted manure, which is either ploughed in or worked with a spade, leaving the surface rough to be acted upon by the frost. In the following spring the surface is again worked over and the soil placed in good order for planting. At the proper period young grapes are again planted as before. These are removed at the end of the season, and the ground receives similar treatment to that of the previous year. Notwithstanding this treatment, the third crop is very indifferent, and if a fourth successive crop is planted it will prove to be an entire failure.

Experience shows that by selecting a field which has never been oc-

cupied with grapes, the young plants will make an average growth of about four feet in length the first year; the average growth of the second year will reach about two feet; the growth of the third year will be exceedingly weak, the best plants reaching to about eighteen inches in length, many weak kinds not reaching the length of one foot.

This result of diminishing yearly growths has not been sensibly affected by the application of different manures, and the question naturally arises that if a deterioration of growth becomes so marked in so short a time, and with such attention to the soil, what may be expected when acres are closely planted with grapes, as in the case of vineyards, where the entire soil speedily becomes filled with roots? It need not be a matter for surprise if vineyards become unproductive after producing several satisfactory crops.

It is well known that nurserymen who pride themselves in maintaining a high standard of quality in their stock of pear or other kinds of fruit trees are careful not to attempt to grow two successive crops on the same land. Even after employing all kinds and quantities of manures that their skill and experience may suggest, the quality of their young stock will depreciate if grown on the same soil unless long periods elapse between the rotations. These and facts of a similar kind might be assumed as an indication that there may be some, as yet unrecognized, cause that exerts an influence in plant nutrition.

Many years ago the hypothesis was advanced that plants secrete or form certain matters during their growth which they exude by their roots, and the accumulation of these ingredients in the soil exercises an injurious influence upon future crops of the same plants, but does not prevent the growth of plants of a different kind. It was even surmised that the exudations of one species furnished nutritious matters for a different species, and for this reason a rotation of crops becomes advantageous and furnishes an explanation for the benefits consequent upon the practice.

The experiments and explanations brought forward in behalf of this hypothesis have not been considered sufficiently conclusive to establish a theory upon which to base any definite action, and has not of late years been entertained as a factor worthy of consideration in the study of plant life or as pertaining to plant culture. And yet every practical cultivator must have observed phenomena in the course of his practice which appears to be more readily explained upon the supposition of the formation of some injurious matters than from the exclusive action of exhaustion; and this may occur without conceding that there is necessarily any function of an excretory character in the roots of plants.

If we attempt to remove a silver-maple tree of three or four years' growth from the seed we will find that the soil closely surrounding the stem, and circling for several feet beyond it is filled with small fibrous roots, mostly dead; active spongioles will be found mainly at the extremities of the larger or main roots. But if we take a tree of the same species which has attained the age of ten years and dig similarly around its stem, we will not find so many fibrous roots as in the case of the younger tree, but instead we will find a few large roots which are destitute of fibers except at their extremities. It seems evident that there is an annual decay of these fibrous roots, and it is a question whether the decomposition of this mass of fiber may not be obnoxious to the plants which produced it, and at the same time not be injurious to plants of a different species.

Instructions relative to the removal and replanting of trees are usually very explicit in regard to the special necessity of protecting the

small fibrous roots because of their great importance to the future growth of the plant. In reality these roots are of no value after they are separated from the soil, as they immediately decay on removal. The larger roots, if healthy and their outer bark uninjured, are only to be depended upon for the emission of an abundance of fresh and vigorous spongioles.

It will be admitted that examples can be found where the same crop has succeeded measurably well on the same soil for a series of years, but close observation and accurate comparisons will show that such instances are rare indeed; but even these successes have not enabled us to remedy the failures, and it seems probable that the causes have not yet been fully explained.

SOWING SEEDS AND RAISING YOUNG PLANTS OF FOREST TREES.

Seeds should be sown as soon as practicable after they are ripe. They will vegetate sooner if sown immediately after being gathered from the plant than they will at any other time. Exposure to the air hardens their outside coverings, which tends to prevent germination; so that the time required for a seed to germinate after being sown depends greatly upon the amount of drying and exposure to the air to which it has been subjected since gathered from the plant. But it is not always practicable or convenient to sow seeds immediately after they are gathered. Some ripen so late in the season that they cannot be sown immediately on account of frost; therefore the alternative is to preserve them in the best manner to retain their vitality and facilitate speedy germination when sown. Among those which do best when sown in the fall are the seeds of the Peach, Cherry, Chestnut, Hazlenut, Walnut, Hickory, Oak, Horse-chestnut, Judas Tree, Hackberry, Yellow Locust, Osage Orange, and the Magnolia. These mostly form very hard shells when exposed to the air for a length of time, and are afterwards very slow to vegetate. If they have to be kept over winter for spring sowing, they should ke kept from the air by mixing them with dry sand, and kept in a cool, ventilated shed or cellar. If kept damp and warm they will either vegetate prematurely or decay. Acorns are specially liable to lose their vegetative power by exposure to dry air. They can be best preserved by spreading them on the surface of the ground in the open air and covering them with one or two inches of light soil or sand, but no water should be allowed to lodge around them; otherwise decay is certain.

There are some seeds that ripen early in summer and will not keep well, consequently have to be sown immediately when gathered, so that the young plants may attain some size and strength before winter. Of these the Silver Maple, Elm, and Poplar may be mentioned. Silver Maple seed is usually ripe in May, and if then sown young plants from two to four feet in height will be produced before winter.

Small seeds, and those which are light and chaffy, such as seeds of the Alder, Birch, Sycamore, Catalpa, Paulownia, Mulberry, and Tulip Tree, as also some of the later-ripening winged seeds, as the Sugar Maple, Negundo, and the species of Ash, should be gathered when ripe, and spread thinly in an airy, shady situation to partially dry, then stored in coarse bags in a cool place until wanted for sowing in spring. Larch, Pine, and seeds of coniferous plants generally, should be kept in a similar manner during winter. Seeds of the Tulip Tree should be sown very thickly; they are mostly very imperfect.

To succeed in raising healthy plants it is essentially necessary that the seed should be sown in deeply worked, light, loamy soil. It should not only be deeply pulverized, but also as rich and fertile as it can be

made. No half-way measures should be tolerated in a thoroughly good preparation of the soil; as a general rule there is altogether too little account made of this greatest source of success, and numerous failures at raising plants from seeds are clearly traced to the use of poor, thin soils, while the want of success is attributed to the poor quality of the seeds, or reflections are cast upon the reliability and good faith of those who furnished them. The most convenient method for after culture is to sow in drills. The distance between the drills will be guided by circumstances. If hand culture only is to be employed, 18 inches apart will be a good distance for most tree seeds, although some of the finer or smaller kinds, and such as require several years' growth before the plants become large enough for removal, may be placed closer. All the pine family belong to this class. The depth of covering will also be regulated by the size of the seed, and to some extent by the kind of soil and the situation. On sandy soils the covering may be deeper than when the soil is liable to form a crust on the surface after rains. This character of soil is not well fitted for raising young plants in dry climates unless rains can be prevented from beating on the surface immediately above the seeds. Acorns and the larger kinds of nuts should be covered with about two inches of soil, and if this covering is composed of light mold and sand, somewhat firmly pressed over the seeds, moisture will be secured more uniformly, and the young shoots will meet with no impediment in their growth; a slight covering of short straw or chaff may be used to great advantage if carefully removed after vegetation has started. Chaff is an admirable covering for seeds, and only the most slender growths will require its removal.

Light and small seeds, such as those of the Birch, Catalpa, Paulownia, and Mulberry, should be sown on the surface of the soil, which is afterwards raked evenly and smoothly without disturbing the regularity of the seeds, and this will afford sufficient covering. By passing a light wooden roller over the surface a finer pulverization will be given, and the pressure will tend to preserve the moisture of the soil from rapid evaporation. A finely pulverized, firm surface acts as a substitute for mulching.

The ordinary care given to crops, such as weeding, hoeing, or merely loosening the surface, will be necessary when the young plants appear above the soil, so as to encourage their growth. There are various kinds of hand-cultivators now in use which answer an admirable purpose in removing weeds from young plants that are in drills, especially on light soils, and even on tenacious soils they can be used to advantage when the soil is softened from previous rains; but judgment is required in selecting the best time to work on these soils; if tramped upon when wet they become caked and lumpy; on the other hand, when stirred at the proper time they can be finely pulverized.

Very small seeds may be sown in boxes and covered with glass, or otherwise protected against rapid evaporation. Such coverings may be removed when the young plants have sufficient roots to supply moisture to the leaves.

TRANSPLANTING.

Small trees are more successfully transplanted than large ones. The size rather than the age of the plant will govern the time of removal from the seed rows or beds. Silver Maples will be large enough for transplanting after one year's growth in ordinary good soil, but most trees will require from two to three years in the nursery before becoming large enough for removal to their final positions, and some slow-growing kinds may re-

quire a first removal to nursery rows, where a further growth of two or three years may be allowed. All this will depend somewhat upon the purposes for which they are to be employed. Trees for avenue or roadside planting require both age and size before being placed in their permanent positions; but in all such cases the trees should be transplanted from the seed-ground into nursery rows, where they remain until required.

If it is intended to plant thickets or belts of trees for the purpose of sheltering and protecting exposed fields or building sites, the plants may be removed at once from the seed-rows to their permanent locations, without going through the preliminary treatment of prescribed nursery culture, as their management in plantations or beltings of limited width should be of the same general character.

The best practical method of rapidly and effectually securing a satisfactory artificial plantation of trees, is to prepare the soil by applying manures, ploughing, harrowing, and attending to other manipulations, as if for a crop of wheat or potatoes. Trees will not grow well on poor soils; in this respect they repay labor and expense in a similar manner to other cultivated crops. The plants should be set out in rows, which may be about 3 feet apart in each direction, which will admit of cultivation the same as for a corn crop, and which will be found to be quite as essential in the growth of trees as it is in the raising of cotton or corn. Unless the plants are over 3 feet in height when removed, but little of pruning will be required at transplanting; but as it will be found impracticable to secure all the roots it becomes a safe process to cut back the tops of the plants to some extent. It is not possible to do more than offer general directions in this matter, as the specific requirements vary almost with each individual plant. But after the first season all weak-looking, crooked, or otherwise unsatisfactory plants should be cut down to within a few inches of the ground, and if more than one shoot starts from these stumps, remove all but the best for the future tree. Such trees as the Catalpa and the Osage Orange, which yield valuable timber, but are naturally of low, branching, and crooked growth, can be drawn up, as it were, into clean, tall stems by cutting them down close to the ground after they have recovered from the check of transplanting.

Fine timber can be produced with as much systematic certainty as fine corn. Thick planting and due regard to judicious thinning as the trees increase in size, together with pruning such branches as seem to interfere with the symmetrical growth of the tree, are some of the essentials in forest management, a subject which has not as yet received much attention in the United States.

ORANGES, LEMONS, ETC.

Several years ago the department imported from Europe a collection of the Citrus family, embracing many varieties of the Orange, Lemon, Lime, &c. The plants were in very bad condition when taken out of the packages, owing to detention on the voyage and other causes; most of them were denuded of foliage and very scant of roots. They were at once planted in pots and placed under suitable conditions for growth. It soon became evident that they were badly infested with a scale insect which greatly retarded their growth and prevented their propagation and distribution. After the failure of many attempts to utterly eradicate this insect, the collection may now be said to be entirely rid of it. This has been effected by the persistent use of a small portion of coal oil applied in water. About one gill of astral oil in five gallons of wa-

ter applied to the plants through a syringe on alternate days for several months has destroyed the insects without injury to the plants; weaker solutions seemed ineffective, and when the oil was increased to an appreciable degree, the young leaves and tender shoots of the oranges were injured.

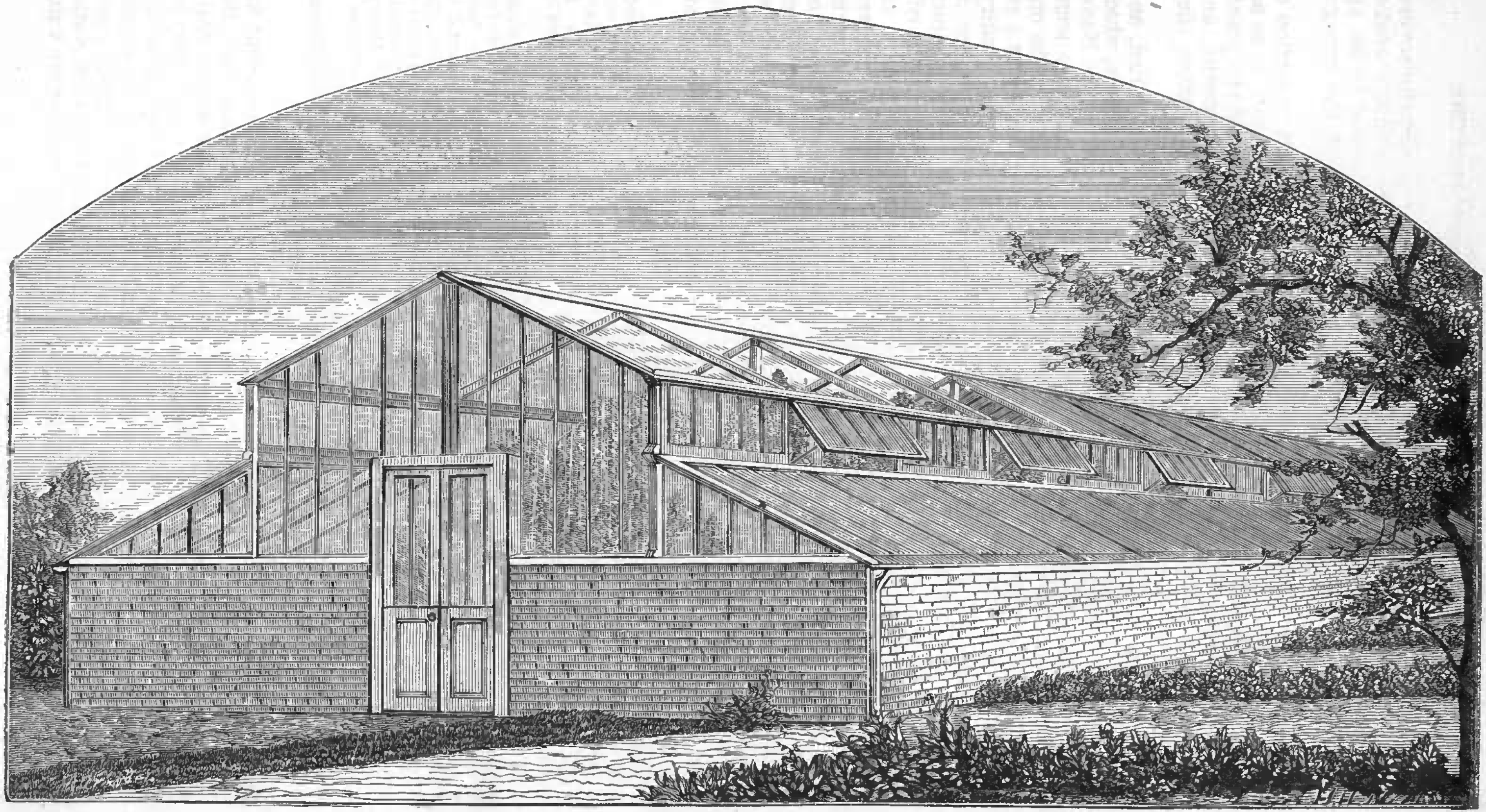
Recently a structure has been erected purposely for this collection of Citrus. The plants are growing in a bed of soil, and a house is so arranged that the roof can be removed during summer, so that the plants have the benefit of open-air culture during the warm months, and the roof being replaced upon the approach of freezing weather, they are thus placed under the best conditions for healthy growth.

Among the most desirable varieties of oranges that have fruited, and have been to some extent disseminated, are the true St. Michaels, which is said to form the bulk of the exportation from the Azores; the Navel or Bahia orange, which, with the former, was sent to California some years ago from the department, and which has proved there to be one of the best varieties yet introduced on the Pacific coast, having at a recent exhibition received the highest encomiums for size and quality. The Maltese oval and the Tangerine, supposed to be the same as the Mandarin, are also esteemed varieties. There is evidently much confusion in the nomenclature of the Citrus family. Even in the collection of the department, although great care was exercised in regard to names, yet it is evident that the same variety is represented under different names, and the same name is found attached to varieties which are evidently distinct. As orange culture becomes extended in this country, the distinctive merits of varieties will be ascertained and noted, so that in time the nomenclature of the Citrus family will become quite as accurate as that of pears and apples.

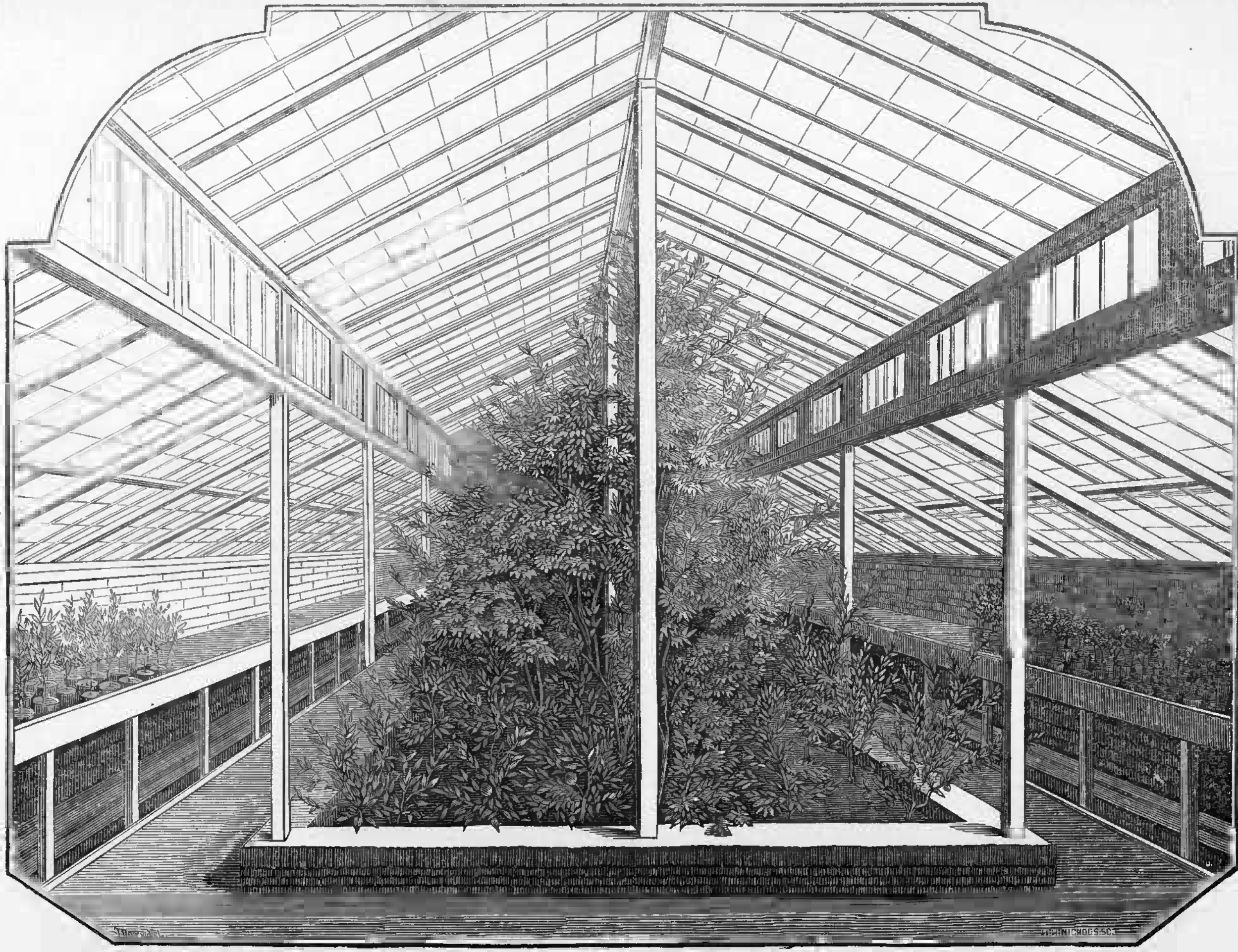
The Citrus Japonica, or Kum-quat of the Chinese, a comparatively hardy species, is thus alluded to by Mr. Robert Fortune in one of his earlier papers on the plants of China and Japan:

> In the south of China great quantities of this species are grown in pots, and hence it is met as a common plant in the nursery gardens at Fa-tee. It is, however, evidently of a more northern origin, for I met with numerous groves of it on the island of Chusan, where it grew in far greater perfection than it does about Canton. It seems also to be largely cultivated in Japan, where it has been seen and described by Japanese travelers.
>
> The Kum-quat groves of Chusan are formed on the sides of the lower hills, in situations where the tea-plant flourishes. The plants are arranged in rows about four feet apart, and do not attain a much larger size than about six feet in height; from three to six feet is the size they are usually seen. A small kind of orange is also found in these groves, but large oranges, such as Mandarins, are entirely unknown; indeed, the Chusan winters would be far too cold for them. This shows that the Kum-quat is of a much hardier nature than any of the orange family with which we are acquainted.
>
> The fruit ripens late in autumn, being then about the size of a large oval gooseberry, having a sweet rind and a sharp acid pulp. It is largely used by the Chinese as a preserve. Preserved in sugar it is excellent.
>
> In China the Kum-quat is propagated by grafting on a prickly wild species of Citrus, which seems of a more hardy nature than the Kum-quat itself.

The Citrus Japonica has been in the collection of the department for many years. There are two varieties, one having oval-shaped fruit, the other having round fruit; the oval-shaped variety has the largest fruit. Efforts have been made from time to time to propagate the plant by grafting on stocks raised from seed of the common orange, but, although the grafts would unite, the plants made no progress in growth, the stocks being unsuited to them. The "prickly wild species of Citrus," upon which the Chinese graft the Kum-quat, is known as the Citrus *trifoliata*, which withstands, it is said, a zero frost. This stock may prove valu-



ORANGE HOUSE, DEPARTMENT OF AGRICULTURE—*Exterior View.*



ORANGE HOUSE, DEPARTMENT OF AGRICULTURE—*Interior View.*

able to orange growers in the Southern States, as it is evident, from invoices of oranges recently received from Japan, that it is there used as a stock for all cultivated varieties.

ORCHARD PLANTING.

It is a common observation that the outer rows of trees in established orchards are finer and more productive than the trees in the interior of the plantation. This superiority is all the more conspicuous if the orchard is bordered by cultivated fields, and it is fair to presume that the extra luxuriance is owing to the trees having a greater extent of unoccupied soil for the ramification of their roots. Something is also, undoubtedly, due to the greater space available for the expansion and spread of the branches; but it is in accordance with all experience in the cultivation of plants that a rotation of crops is absolutely essential toward securing the best results of the fertility of the soil. Keeping these facts in view, it is suggested that an improvement upon the present method of planting orchards would be gained by planting two rows of trees from 18 to 25 or more feet apart, depending upon the nature of the trees, and alternating the plants in the rows. Then allow a space, varying in extent from 300 feet to any greater distance, before planting another series of rows, and so increase the plantation as far as may be desired. The intervening spaces between these double rows of trees would be available for the cultivation of the ordinary crops of the farm. The roots of the trees would not only participate in the benefits of cultivation, but would also have practically, unlimited room for extension before meeting with other roots of their kind. Immediately under the trees, and for a distance on each side of the rows, as far as the branches spread, the surface could be kept in grass. If not sown down immediately after planting, which might not be desirable in all cases, it should be done after the trees attain a fruit-bearing size, or from five to seven years after setting out. The shelter which will be afforded to other crops by these orchard belts will be found valuable as a protection from winds as well as in forwarding early crops. This method is particularly applicable to apple and pear trees.

Respectfully submitted,

WILLIAM SAUNDERS,
Superintendent of Gardens and Grounds.

Hon. W. G. LeDuc,
Commissioner of Agriculture.

REPORT OF THE ENTOMOLOGIST.

Sir: I have the honor to submit the following report of some of the work of the Entomological Division since June, 1878, the date when it was given into my hands.

The correspondence of the division has become quite extensive; and aside from the numerous answers to communications regarding the names and habits of well-known injurious insects and remedies for the same, many species have been received and studied. Among the more interesting and important of these the following are worthy of mention:

The regular Joint-worm (*Isosoma hordei*, Harris) was sent in June by Mr. S. O. Dean, of Grantville, N. C., as seriously injuring wheat in that locality. The Asparagus beetle (*Cicoceris asparagi*, L.) came about the same time from Suffolk County, New York, where Mr. Geo. D. Post, of Quogue, reported it as very serious. The Cottony maple scale (*Pulvinaria innumerabilis*, Rathvon), an insect that has been extremely troublesome to maples and other shade trees in the more northern States, has been sent from as far south as Louisville, Ky., by Mr. J. B. Nall. The Cabbage maggot (*Anthomyia brassicæ*, Bouché) has proved very destructive in Luzerne County, Pennsylvania, according to R. W. Cox, of Providence, who sent specimens. An interesting scale-insect, sent by Mr. Joseph Cohen, of Charleston, S. C., has proved quite injurious to the fig, covering leaves, branches, and fruit. It is a new species of *Mytilaspis*, closely allied to the well-known Muscle-shell bark-louse of the apple, and will doubtless prove a serious interference with fig culture. Thousands of apple trees have been defoliated in parts of Pennsylvania by a little pistol-like case-bearer, belonging to the genus *Coleophora*, never before reported as injurious, and new to science; while several interesting communications relative to the same have been received from Mr. Wm. Fairweather, of the Densmore Apple Farm in McKean County. Similarly extensive young apple orchards belonging to Mr. W. W. Adams, of Waukon, Iowa, have been ravaged and almost destroyed by another new Lepidopterous insect, namely, a species of Tortrix. Still another new apple-leaf pest, which proves upon rearing to be the *Phoxopteris nubeculana* of Clemens, has been received from Mr. O. C. Chapin, of Bloomfield, N. Y., where it has proved very injurious. Mr. Gustavus Pauls, of Eureka, Mo., had his corn seriously damaged at the roots by the larva of a little beetle (*Diabrotica longicornis*, Say.) that was not before known to have any such habits. Twigs of the tea plant badly infested with a bark-louse (*Ceroplastes rusci*, Linn.) have been received from Mr. L. H. Tallman, of Mandarin, Duval County, Florida. A borer affecting the roots of raspberries and blackberries (*Torchilium rubi*, Riley) was reported as doing much damage in Stanley County, North Carolina, by Mr. F. G. Kron, of Albemarle. A sugar-cane borer (*Diatræa sacchari*, Gould), first mentioned as injurious in the island of Mauritius in the year 1836, but not before recorded as occurring in this country, though figured on one of Professor Glover's unpublished plates, was received from Mr. Wm. Pugh, of Assumption, La. One of the commonest flower-beetles (*Euryomia inda*) has been received from several correspondents as attacking green corn—a habit which the species was not before known to possess, and which has, beyond much doubt, been recently acquired. A well-known cottonwood borer (*Saperda calcarata*, Say.) that is proving very destructive in Kansas, Nebraska, and other Western States, has been received from Mr. J. Savage, of Lawrence, Kans., and others; while from the Pacific Slope have come serious complaints of a new insect that is killing many of the orchard and ornamental trees of that section of the country. Specimens received from Mr. A. W. Saxe, of Santa Clara, Cal., show it to be a species of *Dorthesia*, an abnormal bark-louse (family *Coccidæ*). It is an Australian insect (apparently *D. characias*, Westw.), and has of late years been introduced on Australian plants into South Africa, where, as I learn from one of my correspondents, Mr. Roland Trimen, curator of the South African Museum, it has multiplied at a terrible rate and become such a scourge as to attract the attention of the government. It has evidently been introduced (probably on the Blue Gum or *Eucalyptus*)

to California either direct from Australia or from South Africa, and will doubtless become quite a scourge; because most introduced insects are brought over without the natural enemies which keep them in check in their native country, and, consequently, multiply at a prodigious rate. It will be naturally partial to Australian trees, and shows a preference for Acacia, Eucalyptus, Orange, Rose, Privet, and Spiræa.

Much of the more valuable work in the Entomological Division must necessarily be done in the field, and I have twice been to Long Island with a view of studying a new enemy of junipers, a large number of valuable trees of this kind, belonging to Mr. P. H. Foster, of Babylon, having seriously suffered and many of them died from its ravages. This insect proves to be a web-worm (*Dapsilia rutilana*, Hb.,) new to this country and evidently introduced from Europe, where it had long been known to attack junipers, but without doing serious harm. I have also twice visited Yates County, New York, where there has been a singular local irruption of the common Walking-stick (*Diapheromera femorata*, Say.), the insect having of late years abounded to such an extent as to defoliate and in many places to kill outright the timber trees, especially the red oak. Mr. F. C. Snow, of Esperange Farm, Branchport, N. Y., has particularly suffered from this insect. The clover crop at this place and in several counties of Western New York has also been seriously affected by two other insects new to this country, namely, a midge (*Cedidomyia*) that is undescribed, and a little beetle (*Hylesinus trifolii*, Mll.) that works in the root, so thoroughly killing whole fields that the rootless plants would gather before the mower and prevent harvesting. This also has been long known to work in clover in Europe, and must be considered a tolerably recent importation.

While a good deal has in this way been added to our knowledge of a number of insects that may be considered of secondary importance only, from the fact that they are local rather than national in character; and while some of them are treated of in the following pages, I have occupied myself more particularly with four classes of insects that seriously affect American productive industries for good or for evil. These are: 1st. Insects affecting the cotton plant. 2d. Silkworms. 3d. Insects affecting the orange and which so seriously threaten orange culture in Florida. 4th. Insects affecting the cranberry.

The more technical and descriptive matter, which it has been deemed necessary to incorporate, in order to give scientific accuracy, will be printed in smaller type in order that it may be readily skipped by the practical man who cares not for scientific details. The measurements when very small are given in millimeters, as the metric system is destined sooner or later to be generally adopted. One millimeter (1 *mm.*) equals about one twenty-fifth of an inch (more accurately .03937). The figures have been made by myself, with the assistance of Mr. G. Marx, and are usually enlarged, the natural sizes being indicated by hair-lines, or in some other way, at the side. In submitting this report I take pleasure in acknowledging the assistance in all my office work of Mr. L. O. Howard and of Mr. Th. Pergande.

Respectfully submitted, March 1, 1879.

CHARLES V. RILEY,
Entomologist.

HON. WM. G. LE DUC,
Commissioner of Agriculture.

INSECTS AFFECTING THE COTTON PLANT.

Pursuant to an appropriation by the last Congress for the purpose, and in accordance with your instructions, I have carried on a special investigation of the insects injurious to the cotton plant. The commission of inquiry was organized by the appointment of the following gentlemen: As special agents, Prof. J. H. Comstock, of Ithaca, N. Y., whose position as professor of entomology in Cornell University and whose experience with insects injurious to vegetation had well fitted him for such labor; and Prof. A. R. Grote, of Buffalo, N. Y., whom a residence of several years at Demopolis, Ala., and a special study of the cotton worm, had also well prepared for the inquiry. As local agents and observers: Dr. E. H. Anderson, of Kirkwood, Miss.; William J. Jones, of Virginia Point, Tex.; Prof. J. E. Willett, of Macon, Ga.; and Prof. Eugene A. Smith, of Tuscaloosa, Ala. Mr. E. A. Schwarz, of Detroit, Mich., has also been engaged during the winter to visit all the Southern States and the West India islands, with a special view of getting at the facts of hibernation. To Prof. Comstock was assigned the cotton region of Arkansas and Tennessee, and of Mississippi and Alabama north of Vicksburg and Meridian and the Alabama Central Railroad; to Mr. Grote, that of Florida and Georgia, and of Alabama south of the railroad mentioned; while, with the assistance of the local observers, I have myself given more especial attention to the extremities of the belt, viz., Texas, Louisiana, Southern Mississippi, and the Carolinas.

The following circular-letter was prepared for the use of agents, and distributed, with corresponding blanks, to correspondents in the cotton belt. It will explain the scope of the inquiry:

DEPARTMENT OF AGRICULTURE,
Washington, D. C., July 22, 1878.

SIR: The entomologist of the department having prepared a series of inquiries for the special scientific observers to whom has been assigned the duty of studying the history and depredation of the worm known as *Aletia argillacea*, as well as other insects which injure the cotton plant, I have caused copies of these circulars to be printed and sent you, in hope that you may feel interest enough in the subject to make report thereon.

Should you do so, please observe carefully the following suggestions:

Write only on one side of the paper blanks sent; and, if more room is desired to answer fully, write on another sheet, numbering and lettering to correspond with letter and number of question.

If any special points arise before the termination of the season, please communicate freely, marking your envelope "cotton insects."

Respectfully, &c.,

WM. G. LE DUC, *Commissioner.*

THE COTTON-WORM.

This insect (*Aletia argillacea*,* Hübn.) will naturally receive most attention, being, as it is, by far the most injurious of the different enemies of the cotton plant. Data are requested on all the following topics:

PAST HISTORY OF THE COTTON-WORM.

1. Give, so far as you can from trustworthy records, the earliest year in which cotton was grown in your State, county, or locality.

1*a*. During what year (exact or approximate) did the worm first make its appearance in your locality, and as far as you are aware, in the State; in other words, how many years elapsed after cotton first began to be grown before the worm began to work upon it?

1*b*. Specify the years when it has been unusually abundant and destructive.

* The *Noctua xylina* of Say.

INFLUENCE OF WEATHER ON THE INSECT.

2. State what you know from experience of the effects of weather on the insect, and more particularly—
2*a*. The character of seasons most favorable to its increase.
2*b*. The character of the summer and winter—whether wet or dry, mild or severe—that have preceded years in which the worm has been abundant and destructive.
2*c*. Do wet summers favor its multiplication?
2*d*. Effects of different kinds of weather on the eggs.
2*e*. Effects of different kinds of weather on the moths.
2*f*. Month of year when greatest injury is done.

STATISTICS OF LOSSES.

3. Give, as correctly as you can, estimates of the loss to the crop in your county and State during notable cotton-worm years.

MIGRATIONS OF THE MOTHS.

It is a well-established fact that the parent moth of the cotton-worm is often found in autumn many hundred miles away from the cotton belt, and there is no reason to doubt that it is often carried by favorable winds to northward regions where it cannot perpetuate its species and must therefore perish. Mr. A. R. Grote and others even believe that the species perishes each year with the plant, and that the moth always comes into the cotton States from more Southern countries, where the cotton plant is perennial; in other words, that the moth is habitually migratory and cannot survive the winter in the great cotton regions of the States. While there are many facts that lend weight to this theory, there is, also, much to be said against it; and we desire to collect all facts that in any way bear on the question. While we hope to get much valuable information on this head from the Signal Bureau, we also ask for the experience of correspondents.

4. Please state, therefore, as nearly as you can from the records, the *prevailing* direction and force of the wind in your locality, first,
4*a*. In the month of February; second,
4*b*. In the month of March; third,
4*c*. In the month of April; fourth,
4*d*. In the month of May; fifth,
4*e*. In the month of June; sixth,
4*f*. Whether, in your opinion, there are winds from the south that are sufficiently strong and constant to counteract the prevailing trade winds which are toward the equator.
4*g*. The prevailing direction of the wind from July till frost.
4*h*. The side of a field on which the worms first begin to work.
4*i*. Do local topographical features influence the extent of the worm's ravages?
4*j*. Does or can the worm feed upon any other plant than cotton, and have you ever known it to do so?

HABITS AND NATURAL HISTORY.

These have already been studied, and are pretty well known; but experience will differ somewhat with locality, and we call attention to the following topics:

5. State the time when the first moths are noticed in your locality.
5*a*. Date when the first worms have been noticed in past years.
5*b*. Date when the last worms have been seen in past years, or were noticed the present year.
5*c*. Number of broods or generations of the worms generally produced.
5*d*. In what other situations besides the folded cotton leaves have you known the worms to spin?
5*e*. Have you ever known the chrysalis to survive a frost, or to be found in sound and healthy condition in winter?
5*f*. Have you ever found the moth hibernating or flying during mild winter weather?
5*g*. How late in the spring has the moth been found alive?

NATURAL ENEMIES.

It is a little singular that no enemies of the cotton-worm have hitherto been reported. That the insect has its enemies, both special and general, there can be little doubt, and we would ask particular attention to the following topics:

6. Are any birds, quadrupeds, or reptiles known to attack the insect in your locality?
6*a*. Are any predaceous insects or parasites known to prey upon it, either in the egg, larva, or chrysalis state?

REMEDIES AND METHODS OF DESTRUCTION.

7. What has been the result of the efforts to allure and destroy the moths, and what methods have proved most satisfactory? Give your estimate of the relative value for this purpose of poisoned sugar, molasses and vinegar, and fires.

7a. Are the moths most attracted to sweetened substances when smeared onto trees, boards, etc., or when contained in vessels in or near which lamps may be lighted?

7b. Are any flowers known to be attractive to the moth? If so, specify them and their season of blooming.

7c. What do you know of your own observation of the influence of jute grown near or with the cotton?

7d. Has any effort been made to destroy the moth in its winter quarters?

7e. Have any systematic and organized attempts been made to gather and destroy the chrysalides, or to facilitate their collection and destruction by furnishing inviting material for the worms to spin up in?

7f. What has been done toward destroying the eggs?

7g. Has anything been found more generally useful and applicable or cheaper than the use of the Paris green mixture to destroy the worms?

7h. Have you known of any injurious effects following the use of this poison, either to the plant, to man, or to animals?

7i. State what you consider the best and most effective method of destroying them in your section.

7j. State the cost per acre of protecting a crop by the best means employed.

☞ *We shall be glad to receive figures, either photographs or drawings, of machines or contrivances employed for the wholesale use of the Paris green mixture, either in the fluid state or as a powder; or any other kinds of machines or traps employed for the destruction of the insect. Models of such are still more desirable, and may be sent by express unpaid to the department.*

OTHER COTTON INSECTS.

There are many other insects that attack and do more or less injury to the cotton plant. Many of these have been figured and referred to by the former entomologist to the department, Mr. Townend Glover, but there is much yet to learn of their habits and natural history and of the best means of subduing them. Specimens of all insects that may be found upon the plant are, therefore, earnestly solicited, with accounts of their work and habits and the amount of injury they do. These specimens are best sent by mail, in tight tin or wooden boxes. If living (and all found feeding on the plant should thus be sent) a supply of food should be inclosed with them; if first killed, they should be carefully packed in a little cotton to prevent shaking and breaking.

☞ *Correspondents who desire to make especial observations with a view of replying to this circular, and who wish further information as to the best manner of preserving specimens, will receive assistance and further instructions upon communicating with the department.*

CHAS. V. RILEY,
Entomologist.

Two circumstances have somewhat interfered with the inquiry, viz., the yellow fever and the general freedom of the plant from the cotton-worm, the serious injuries of this last having been restricted to the cane-brake regions of Alabama and to the southwest counties of Georgia, especially the country between the forks of the Flint and Chattahoochee Rivers—the more malarious portions of either State. Its appearance in injurious numbers both here and in South Texas was from four to six weeks later than usual, and this was one cause of the small amount of injury done. The weather at the time of their greatest abundance was wet and interfered with the application of remedies.

Professor Comstock's observations were chiefly confined to that fertile cotton-growing region along the line of the Alabama Central Railroad known as the "cane-brake." He reached Selma July 20. There he met many prominent planters, and from them collected important statistics respecting the occurrence of the cotton-worm and the results of experiments in the use of remedies for this species. July 23 he began his field observations near Uniontown, Perry County, and from that time on, till the middle of October, he was constantly engaged in studying the habits of cotton insects on plantations in Dallas, Perry, Hale, and Marengo Counties. His only absence from this region was from August 10 to August 15, when I directed him to make a trip through the State northward as far as Madison County, where much cotton is grown. Professor Comstock has prepared a full and valuable report, which will be incorporated in the final report of the investigation.

Professor Grote's operations will appear by the following extract from a brief report submitted:

SIR: In accordance with your favor of July 18 in which you directed me to visit the States of Georgia and Florida for the purpose of making observations on the insects injurious to the cotton plant, I proceeded to Savannah and during the following month of August made examinations of cotton fields at different points between Savannah and Atlanta. Having charged me especially with that phase of the cotton-worm inquiry which comes under the head of migrations, I directed my chief attention to making observations and collecting information on the appearance and movements of the cotton-worm (*Aletia argillacea*). * * *

A careful survey of the plantation of Dr. Lawton, near Savannah, from August 1 to August 7, and other cotton-patches in the vicinity convinced me that the worm had not then appeared. The statements made to me were to the effect that its earliest appearance was usually to be looked for about the middle of the month. Henry Gaston, engaged in planting cotton for nearly twenty years, said that the first brood of worms usually web up about the middle to latter part of August, giving a second brood in September. The worm was first noticed in the stronger cotton on the bottom lands. * * * He had observed the moth before the appearance of the worm, but had never noticed it in the early spring.

This testimony is given as a sample of the information collected from various individuals. While August seems to be the usual time for the appearance of the worm on the main-land on the coast of Georgia in the neighborhood of Savannah, the testimony of Dr. J. S. Lawton, on the sea islands off the coast of South Carolina to the northward of Savannah, is to the effect that the worm appears sometimes as early as July and is then usually excessively injurious to the long staple cottons.

In Southwestern Georgia the worm is noticed as early as the last week in June in some years, and the main damage inflicted in the State seems to come from this quarter. The worm occurs there every year, though the date at which it is noticed varies. The question whether the earliest so-called "brood" is the first appearance of the worm in any quarter has been raised by yourself, and is one to which I hope to be able to pay close attention in the spring.

For the present we must accept the testimony that the worm seems to advance from Southwest Georgia over the western and occasionally over the central portion of the State. It seems to come from Decatur to Baker, Calhoun, Dougherty, and Lee Counties. According to present testimony its appearance is not simultaneous over this section of the State, the southern portions being first visited.

From testimony collected by myself in Athens, on the occasion of the meeting of the Agricultural Society of Georgia, the following counties are visited by the cotton-worm every year, though the exact time is not, according to testimony, the same: Calhoun, Decatur, Dougherty, Lee, Macon, Schley, Taylor.

Counties in which the worm is not noticed every year are: Burke, Clarke, Fulton, Greene, Hancock, Jones, Monroe, Putnam, Richmond.

It will be seen that the central portion of the State is less subject to the devastation of the cotton-worm than the southwestern and western. * * *

I received in November, 1878, fresh instructions from you to proceed to Georgia for the purpose of ascertaining whether I could find eggs from the last moths on any portion of the plant, and any facts bearing upon the hibernation of the moth. On the plantations near Savannah I found that the worm was first noticed the current year on September 4. I found a large number of the chrysalides yet on the plant on November 10 to 25. The nights were frosty and the leaf withered and scant. In places sheltered by trees the leaf was still green, and here I found (November 16) a few caterpillars not yet spun up. A large number of the chrysalides were empty; about 40 per cent. contained parasites. Less than a quarter of the chrysalides contained the undeveloped moth. * * *

Under your instructions I visited the Georgia sea-islands during the end of November and beginning of December. I found that the worm had appeared this year in September as on the main-land, but later in the month. It had, also, not spread, and had attacked certain corners of the fields, where I now found the chrysalides. None of these contained undeveloped moths; they were either empty or ichneumonized. There had been no second brood of worms on the islands, according to testimony collected by me, and which was borne out by my own observations. * * *

As the result of my late observations I may say that the fact, I think first announced by myself, is confirmed, that the cotton-worm passes the winter, when it survives at all, as a moth, and that the last fall worms do not leave the plant to web up. The full history of the worm in Georgia can be made out when the country is fully explored in the spring and before the first appearance of the worm in numbers. It will then be made clear where the first large numbers of the worm come from; whether they are the results of fresh invasions of the moth or are the product of a first generation from eggs of hibernating individuals. * * *

Under your intelligent supervision of the inquiry, and with the facilities which you possess from different sections of the South, I have no doubt that this important matter will receive final and full elucidation.

My thanks are due to Mr. Z. Bauers, of Saint Catharine's Island; Dr. W. S. Lawton, of Savannah; Messrs. T. G. Holt, of Macon, Ga.; J. E. Redwine, Hull County, Georgia; E. C. Grier, Griswoldville, Jones County; J. Pinckney Thomas, Wayne's Bluff, Burke County, Georgia; State Geologist, George A. Little, of Atlanta, Ga., and others, who have assisted me in my work.

Yours, respectfully,

A. R. GROTE.

Prof. C. V. RILEY,
Entomologist Department Agriculture.

Starting south myself the latter part of August, I passed through Tennessee to Mitchell County in Southwest Georgia, and thence, during September, through the cotton sections of the southeastern part of that State and of the Carolinas and Virginia. I was at this time made painfully aware of the hindering effects of the yellow fever. One can scarcely conceive of the panic and excitement that prevailed, even in regions where there was little or no danger. But a few weeks before in the thicker cotton counties of Alabama and Georgia the prevailing topic of conversation, as I learned, was the work of the Cotton-worm. At the time of my visit its injuries were forgotten in the all-absorbing subject of the epidemic. Cotton fields were neglected, and in sight of acres of stripped and spindling stalks one heard but the universal refrain—yellow fever, yellow fever. It seriously interfered with my own plans, and obliged me to avoid the very Mississippi cotton-fields which I desired most to visit.

Notwithstanding this serious drawback to the present year's operations, much that is valuable and important has been learned. There is a very general want of knowledge among the people of the South regarding the real habits of the Cotton-worm, and I find that the opinions of the most observant are seldom founded on intelligent observation; and that such opinions are consequently of little value. This state of things is due to three evident causes: First, the general unhealthiness of the region in which the insect does most damage, and the intense heat that prevails during the months when most of the observations must be made; second, the fact that the culture of the crop is turned over to uneducated and unobserving negroes; third, the failure to discriminate between the Cotton-worm and the Boll-worm (*Heliothis armigera*) in their later stages, and the natural difficulty that besets the solution of some of the questions, such as the winter habits of the *Aletia*.

It had often been a wonder to me that no true parasite had ever been found infesting this insect, since there scarcely exists a plant-feeding species that is not attacked by some parasite. No less than nine distinct species of these parasites have been discovered on the Cotton-worm this summer, and this fact has an important bearing on several of the knotty questions that present themselves in our inquiry. Again, I had wondered what plants the moths naturally fed from, since it was known to be fond of sweets, and had, to my knowledge, done considerable injury by boring into various ripe fruits. The cotton plant is peculiar for having a gland on the under side of from one to three ribs of the more mature leaves, and a still larger gland at the outer base of the three lobes of the involucre. As soon as I learned that these glands secreted a sweetened liquid, I inferred that the plant would be found to furnish nourishment to the moth as well as to the larva, and drew attention to this belief in the Atlanta (Ga.) *Constitution*, of September 8, 1878. It was with no small degree of pleasure that at Baconton subsequently, in company with Professors Comstock and Willett, I was able to prove my

anticipation correct, by studying the normal habits of the moth with a dark-lantern at night. The moth is, therefore, attracted to the plant by the sweets which this last affords, and as these sweets are first produced when the plant begins to flower and fruit, we have here a possible explanation of the well-known fact that the worm is seldom noticed on the young plant till about the time of fruiting. We have also discovered that the moth feeds on the honey copiously secreted from glands occurring at the apex of the peduncle just above the pods of the cow-pea (*Dolychos*), extensively grown through the South as a forage plant; also on the sweet exudation from the flowers of *Paspalum læve*, a tolerably common grass. It is by taking advantage of this love for sweets which the moth possesses that we shall probably arrive at one of the most effectual ways of preventing the ravages of the worm, for if we can allure the first moths of the season to certain death, we nip the evil in the bud.

It is my desire to make the investigation thorough and exhaustive, and to place the results before the public in a special report to Congress, since it will be impossible to extend this present report of progress, which is but preliminary, without exceeding the limits which you have allowed me in this annual report. When we reflect on the immense losses the South has sustained during the best part of a century from the ravages of the Cotton-worm and other cotton insects, it is surprising that no systematic investigation had before been made by the government, and now that the investigation has been commenced it is very desirable that it be completed in a thorough manner. This effort to prevent at least a portion of the vast losses sustained by cotton-growers from insect injury is fully appreciated and applauded by the people of the South, who certainly need at this time all the encouragement the government can give.

THE SILK-WORM: A BRIEF MANUAL OF INSTRUCTIONS FOR THE PRODUCTION OF SILK.

The following instructions for the production of silk have already been issued in pamphlet form, in small edition, to meet the demand made upon the department for the information, and anticipating its appearance in the annual report:

Whatever opinions may be held as to the feasibility or as to the profits of silk-culture in this country, the desire for information on the subject and the ambition to embark in the industry evinced by correspondents of the department demonstrate the fact that there will be no difficulty in getting our people to turn their attention to it. Without going into details as to the history of past attempts at silk-culture in North America, it must be obvious to all who thoroughly investigate them that the causes of failure have ever been transient ones. They may be summed up in the statements that (1) labor has found more profitable avenues of employment, and (2) that there has been no home market for the cocoons. At the present time the first statement no longer has force, but the second holds as true now as it ever did.

As a means of meeting the difficulty, I have urged, and would urge, that Congress give to this department the means to purchase, erect, and appoint with skilled hands, on the department grounds, a small filature or reeling establishment. In such an establishment reelers could be trained, and the cocoons, at first raised from eggs distributed by the department, could be skillfully reeled and dis-

posed of to our manufacturers. A market would thus be formed for the cocoons raised in different parts of the country, and a guarantee be given to those who choose to embark in silk-culture that their time would not be thrown away. All industries should be encouraged in their infancy; and for the first few years, or until the silk industry could be considered well established, the cocoons should be paid for at the European market rate, plus the cost of reeling, which would range from 50 cents to 75 cents per pound of choked cocoons. This last should be looked upon as a premium offered by the government to the raisers, in order to stimulate the industry until such time as the reeling might be safely left to private enterprise, when government encouragement could be withdrawn.

Meanwhile, and pending Congressional aid, those who desire to raise silk-worms in this country for profit have three alternatives, either (1) to ship the choked cocoons to Europe, (2) to reel them, or (3) to raise eggs and sell these.

(1) That the children and more feeble persons in a household may find profitable employment in raising cocoons to be shipped abroad is proved by the case of Mr. E. Fasnach, of Raleigh, N. C., who has for several years been in the habit of thus shipping the cocoons reared by his family. He sends in bales, 6 by 5 feet in size, and averaging about 40 pounds of stifled cocoons, for which he has obtained as high as $2.50 per pound net, the freight costing only $3 per hundred pounds between Raleigh and Marseilles. Mr. B. A. Weber, of Rockford, Ill., last year raised 40 pounds of cocoons, and also shipped to Europe through New York brokers; and others have done likewise; but I would advise no one to invest capital on this basis.

(2) Nor would it be safe for individuals to rely on reeling their own silk. The art of reeling in modern filatures and with steam appliances has been brought to such perfection that the hand-reeler cannot hope to produce a first-class article. The only way in which silk-reeling can be managed profitably, at present, is where a colony of silk-raisers combine to put up and operate a common filature, as in the case of the settlement at Silkville, Kans., the colony of French and Italians who located at Fayetteville, N. C., in 1876, or the Italian settlement at Vineland, N. J.

(3) Under existing circumstances, more money has been made by the sale of eggs than by either of the other means, and silk-worm growers in this country have gradually drifted into this branch of the industry. Eggs raised in this country are free from disease, and the fact that as high as $6 and $8 per ounce have been paid for them, and that France paid in 1876 114,000 francs and in 1877 1,691,400 francs for eggs exported from the United States,* is as eloquent in showing the remarkable adaptation of our country to silk-culture as that other fact, not generally known, that the chief of the French commission to our Centennial confessed that there was no silk in France superior to some that was there on exhibition and grown in North Carolina. The production of a certain number of eggs does not necessarily prevent the production at the same time of choked cocoons or reeled silk; and the pierced cocoons that have been used for breeding purposes have also a certain market value, commanding about $1 per pound at Patterson, N. J. This egg-producing branch of the industry can, however, only admit of a limited expansion.

As a means of indicating the profits in silk-culture I have prepared the subsidiary estimates. Optimistic theorists have done much harm in

* These figures are on the authority of the *Moniteur des Soies* for January 18, 1879, but they may include also those received from China through the United States.

the past by making fabulous calculations as to the profits of silk-culture. The figures here given are based on data furnished by men like Messrs. E. V. Boissière and L. S. Crozier, of Silkville, Kans., E. Fasnach, of Raleigh, N. C., T. N. Dale, of Patterson, N. J., &c., and on the current prices as quoted in the *Moniteur des Soies*. They are in every sense moderate estimates, but it must not be forgotten that they do not include capital invested in the shape of food-plants. As yet, and until Congress gives the necessary encouragement, it were safest for those only to embark in this culture who already have mulberry trees to use or who decide to feed Osage orange.

PROFITS OF PRODUCING COCOONS: ESTIMATES FOR TWO ADULTS, OR MAN AND WIFE.

Average number of eggs per ounce, 40,000.
Average number of fresh cocoons per pound, 300.
Average reduction in weight for choked cocoons, 66 per cent.
Maximum amount of fresh cocoons from one ounce of eggs, 130 to 140 pounds.

Allowing for deaths in rearing—26 per cent. being a large estimate—we thus get, as the product of an ounce of eggs, 100 pounds of fresh or 33 pounds of choked cocoons.

Two adults can take charge of the issue of from 3 to 5, say 4, ounces of eggs, which will produce 400 pounds of fresh or 133 pounds of choked cocoons.

Price per pound of fresh cocoons (1878), 50 cents.
Four hundred pounds of fresh cocoons, at 50 cents, $200.
Price per pound of fresh cocoons (1876), 70 cents.
Four hundred pounds of fresh cocoons, at 70 cents, $280.

Actual sales in Marseilles, December, 1878, of choked cocoons, 15 francs per kilogram, or $1.66 per pound, which for 133 pounds choked cocoons would be $220.78.

Price per pound of choked cocoons (1876), $2.25; 133 pounds of choked cocoons at $2.25, $299.25.

Freight, packing, commissions, and other incidental expenses, say $25, making as the return for the labor of two persons for six weeks, at the present low prices, $195.78.

Calculating on the basis of $1.50 per pound of choked cocoons, which, as shown in the following estimates, a reeling establishment in this country could afford to pay, we get approximately the same amount, viz., $199.50. As already stated, the capital invested in food for the worms is not included in these estimates, nor is the first cost of the ounce of eggs deducted. The silk grower should raise his own "seed," and the time required for this purpose is more than compensated for by the time saved in feeding during the first and second ages of the worms, when the whole time of two adults is not required as it is subsequently.

APPROXIMATE PROFITS OF REELING.

One pound of reeled silk requires 3⅔ pounds of choked cocoons.
An expert can in six days reel 4½ pounds of raw silk.
Price of best raw silk in French market, 1878 (market very low), $8.50 per pound.
Nine pounds of raw silk, at $8.50, $76.50.

The discount for cash, commissions for selling, and transportation would reduce this to $65.42.

To produce 9 pounds of raw silk would require the labor of two reelers for six days, at $1 per day, or $12; adding to this $2.50 for indirect labor, we get $14.50 as the cost of labor in reeling 9 pounds.

Thus the labor to reel 1 pound of raw silk will cost $1.70, or that to reel 1 pound of choked cocoons, approximately, 50 cents.

Deducting the cost of reeling from the $65.42 obtained, we have $50.92 with which to buy the necessary cocoons; say 33 pounds of choked cocoons for the 9 pounds reeled silk. If we use $49.50 of this sum for this purpose, it will enable us to pay $1.50 per pound for our cocoons and we still have $1.42 as a profit on every 9 pounds of raw silk manufactured. This, if we employed two hundred reelers, would be a yearly income of $7,384.

It is safe to say that the process of reeling just about doubles the value of the product, and if the silk-raiser can reel his own cocoons he may safely count on this increase of its value, provided it is *well* reeled.

What the actual profits are that accrue to the owners of the large filatures in Tarasson and other parts of South France or Italy, it would be impossible to state without having access to the books of the companies.

ESTIMATE OF PROFITS IN RAISING EGGS.

Average number of eggs in an ounce, 40,000.
Maximum number of cocoons from one ounce of eggs, 40,000.
One-half of these, or 20,000, are females.
Number of eggs laid by each female, say, 300.
Quantity of eggs from one ounce, 6,000,000, or 150 ounces.
Deducting, as probable loss from all causes combined, one-half, we have 75 ounces.
Price of eggs in Europe, $2 to $5; say, $3 per ounce.
Amount realized on 1 ounce, $225.

On the basis of the first estimates two adults could take charge of the issue from 4 ounces of eggs. These would yield the sum of $900, and, even after allowing for the first cost of eggs, trays, commission, freight (which is light), extra time and labor (say another month), and incidental expenses, it leaves a very excellent return.

In studying the above estimates the reader must bear in mind that the silk industry, like all industries, will have its ups and downs—its periods of buoyancy and depression. It is just now going through one of these last. Silk-culture never was and never will be an exceedingly profitable business, but it adds vast wealth to the nations engaged in it, for the simple reason that it can be pursued by the humblest and poorest, and requires so little outlay. The question of its establishment in the United States is, as I have elsewhere said, "a question of adding to our own productive resources. There are hundreds of thousands of families in the United States to-day who would be most willing to add a few dollars to their annual income by giving light and easy employment for a few months each year to the more aged, to the young, and especially to the women of the family, who may have no other means of profitably employing their time.

"This holds especially true of the people of the Southern States, most of which are pre-eminently adapted to silk-culture. The girls of the farm, who devote a little time each year to the raising of cocoons, may not earn as much as their brothers in the field, but they may earn something, and that something represents an increase of income, because it provides labor to those members of society who at present too often have none that is remunerative.' Further, the raising of a few pounds of cocoons each year does not and need not materially interfere with the household and other duties that now engage their time, and it is by each household raising a few pounds of cocoons that silk-culture must, in the end, be carried on in this as it has always been in other countries. Large rearing establishments seldom pay."

In what follows there has been no attempt to give a detailed treatise on the silk industry. It has been the endeavor rather to convey the more important information required for beginners. The few quotations are from the writer's fourth report on the insects of Missouri (1871), and it is hoped that, by the aid of a closing glossary of the few unavoidable technical terms that are used, the language will be clear to all.

NATURE OF THE SILK-WORM.

The silk-worm proper, or that which supplies the ordinary silk of commerce, is the larva of a small moth known to scientific men as *Sericaria mori*. It is often popularly characterized as the Mulberry Silk-worm. Its place among insects is with the *Lepidoptera*, or Scaly-winged insects, family *Bombycidæ*, or Spinners. There are several closely allied species, which spin silk of different qualities, none of which, however, unite strength and fineness in the same admirable proportions as does that of the mulberry species. The latter has, moreover, acquired many useful peculiarities during the long centuries of cultivation it has undergone.

It has in fact become a true domesticated animal. The quality which man has endeavored to select in breeding this insect is, of course, that of silk-producing, and hence we find that, when we compare it with its wild relations, the cocoon is vastly disproportionate to the size of the worm which makes it or the moth that issues from it. Other peculiarities have incidentally appeared, and the great number of varieties or races of the silk-worm almost equals those of the domestic dog. The white color of the species, its seeming want of all desire to escape as long as it is kept supplied with leaves, and the loss of the power of flight on the part of the moth, are all undoubtedly the result of domestication. From these facts, and particularly from that of the great variation within specific limits to which the insect is subject, it will be evident to all that the following remarks upon the nature of the silk-worm must necessarily be very general in their character.

The silk-worm exists in four states—egg, larva, chrysalis, and adult or imago—which we will briefly describe.

DIFFERENT STATES OR STAGES OF THE SILK-WORM.

THE EGG.—The egg of the silk-worm moth is called by silk-raisers the "seed." It is nearly round, slightly flattened, and in size resembles a turnip-seed. Its color when first deposited is yellow, and this color it retains if unimpregnated. If impregnated, however, it soon acquires a gray, slate, lilac, violet or even dark green hue, according to variety or breed. It also becomes indented. When diseased it assumes a still darker and dull tint. With some varieties it is fastened to the substance upon which it is deposited by a gummy secretion of the moth produced in the act of ovipositing. Other varieties, however, among which may be mentioned the Adrianople whites and the yellows from Nouka, in the Caucasus, have not this natural gum. As the hatching point approaches, the egg becomes lighter in color, which is due to the fact that its fluid contents become concentrated, as it were, into the central, forming worm, leaving an intervening space between it and the shell, which is semi-transparent. Just before hatching, the worm within becoming more active, a slight clicking sound is frequently heard, which sound is, however, common to the eggs of many other insects. After the worm has made its exit by gnawing a hole through one side of the shell, this last becomes quite white. Each female produces on an average from three to four hundred eggs, and one ounce of eggs contains about 40,000 individuals. It has been noticed that the color of the albuminous fluid of the egg corresponds to that of the cocoon, so that when the fluid is white the cocoon produced is also white, and when yellow the cocoon again corresponds.

THE LARVA OR WORM (Pl. I, Fig. 1).—The worm goes through from three to four molts or sicknesses, the latter being the normal number. The periods between these different molts are called "ages," there being five of these ages including the first from the hatching and the last from the fourth molt to the spinning period. The time between each of these molts is usually divided as follows: The first period occupies from five to six days, the second but four or five, the third about five, the fourth from five to six, and the fifth from eight to ten. These periods are not exact, but simply proportionate. The time from the hatching to the spinning of the cocoons may, and does, vary all the way from thirty to forty days, depending upon the race of the worm, the quality of the food, mode of feeding, temperature, &c.; but the same relative proportion of time between molts usually holds true.

The color of the newly hatched worm is black or dark gray, and it is covered with long stiff hairs, which, upon close examination, will be found to spring from pale-colored tubercles. Different shades of dark gray will, however, be found among worms hatching from the same batch of eggs. The hairs and tubercles are not noticeable after the first molt, and the worm gradually gets lighter and lighter until, in the last age, it is of a cream-white color. When full grown it presents the appearance of Fig. 1, Pl. I. It never becomes entirely smooth, however, as there are short hairs along the sides, and very minute ones, not noticeable with the unaided eye, all over the body.

The preparation for each molt requires from two to three days of fasting and rest, during which time the worm attaches itself firmly by the abdominal prolegs (the 8 non-articulated legs under the 6th, 7th, 8th and 9th segments of the body, called prolegs in contradistinction to the 6 articulated true legs under the 1st, 2d, and 3d segments), and holds up the fore part of the body, and sometimes the tail. In front of the first joint a dark triangular spot is at this time noticeable, indicating the growth of the new head; and when the term of "sickness" is over the worm casts its old integument, rests a short time to recover strength, and then, freshened, supple, and hungry, goes to work feeding voraciously to compensate for lost time. This so-called "sickness" which preceded the molt, was, in its turn, preceded by a most voracious appetite which served to stretch the skin. In the operation of molting the new head is first disengaged from the old skin, which is then gradually worked back from segment to segment until entirely cast off. If the worm is feeble, or has met with any misforture, the shriveled skin may remain on the end of the body, being held by the anal horn; in which case the indvidual usually perishes in the course of time. It has been usually estimated that the worm in its growth consumes its own weight of leaves every day it feeds; but this is only an approximation. Yet it is certain that during the last few days before commencing to spin, it consumes more than during the whole of its previous worm existence. It is a curious fact, first noted by Quatrefages, that the color of the abdominal prolegs at this time corresponds with the color of the silk.

Having attained full growth the worm is ready to spin up. It shrinks somewhat in size, voids most of the excrement remaining in the alimentary canal; acquires a clear, translucent, often pinkish or amber-colored hue; becomes restless; ceases to feed, and throws out silken threads. The silk is elaborated in a fluid condition in two long, slender, convoluted vessels, one upon each side of the alimentary canal. As these vessels approach the head they become less convoluted and more slender, and finally unite within the spinneret from which the silk issues in a glutinous state and apparently in a single thread. The glutinous liquid which combines the two, and which hardens immediately on exposure to the air, may, however, be dissolved in warm water. The worm usually consumes from three to five days in the construction of the cocoon, and then passes, in three days more, by a final molt, into the chrysalis state.

THE COCOON (Pl. I, Fig. 2).—The cocoon consists of an outer lining of loose silk, known as "floss," which is used for carding, and is spun by the worm in first getting its bearings. The amount of this loose silk varies in different breeds. The inner cocoon is tough, strong, and compact, composed of a firm, continuous thread, which is, however, not wound in concentric circles as might be supposed, but irregularly, in short figure of 8 loops, first in one place and then in another, so that in reeling several yards of silk may be taken off without the cocoon turn-

ing round. In form the cocoon is usually oval, and in color yellowish, but in both these features it varies greatly, being either pure silvery-white, cream or carneous, green, and even roseate, and very often constricted in the middle. It has always been considered possible to distinguish the sex of the contained insect from the general shape of the cocoon, those containing males being slender, depressed in the middle, and pointed at both ends, while the female cocoons are of a larger size and rounder form, and resemble in shape a hen's egg with equal ends. Mr. Crozier, however, emphatically denies this, and thinks it "next to impossible for the smartest connoisseur not to be mistaken."

THE CHRYSALIS.—The chrysalis is a brown, oval body, considerably less in size than the full-grown worm. In the external integument may be traced folds corresponding with the abdominal rings, the wings folded over the breast, the antennæ, and the eyes of the inclosed insect—the future moth. At the posterior end of the chrysalis, pushed closely up to the wall of the cocoon, is the last larval skin, compressed into a dry wad of wrinkled integument. The chrysalis state continues for from two to three weeks, when the skin bursts and the moth emerges.

THE MOTH (Pl. I, Fig. 3).—With no jaws, and confined within the narrow space of the cocoon, the moth finds some difficulty in escaping. For this purpose it is provided, in two glands near the obsolete mouth, with a strongly alkaline liquid secretion, with which it moistens the end of the cocoon and dissolves the hard gummy lining. Then, by a forward and backward motion, the prisoner, with crimped and damp wings, gradually forces its way out, and when once out the wings soon expand and dry. The silken threads are simply pushed aside, but enough of them get broken in the process to render the cocoons from which the moths escape comparatively useless for reeling. The moth is of a cream color, with more or less distinct brownish markings across the wings, as in Fig. 3. The males have broader antennæ or feelers than the females, and may by this feature at once be distinguished. Neither sex flies, but the male is more active than the female. They couple soon after issuing, and in a short time the female begins depositing her eggs, whether they have been impregnated or not. Very rarely the unimpregnated egg has been observed to develop.

ENEMIES AND DISEASES.

As regards the enemies of the silk-worm but little need be said. It has been generally supposed that no true parasite will attack it, but in China and Japan great numbers of the worms are killed by a disease known as "uji," which is undoubtedly produced by the larva of some insect parasite. Several diseases of a fungoid or epizoötic nature, and several maladies which have not been sufficiently characterized to enable us to determine their nature, are common to this worm. One of these diseases, called *muscardine*, has been more or less destructive in Europe for many years. It is of precisely the same nature as the fungus (*Empusa muscæ*), which so frequently kills the common house-fly, and which sheds a halo of spores, readily seen upon the window-pane, around its victim.

A worm, about to die of this disease, becomes languid, and the pulsations of the dorsal vessel or heart become insensible. It suddenly dies, and in a few hours becomes stiff, rigid, and discolored; and finally, in about a day, a white powder or efflorescence manifests itself, and soon entirely covers the body, developing most rapidly in a warm, humid atmosphere. No outward signs indicate the first stage of the disease, and

though it attacks worms of all ages, it is by far the most fatal in the fifth or last age or stage, just before the transformation.

"This disease was proved by Bassi to be due to the development of a fungus *(Botrytis Bassiana)* in the body of the worm. It is certainly infectious, the spores, when they come in contact with the body of the worm, germinating and sending forth filaments which penetrate the skin, and upon reaching the internal parts give off minute floating corpuscles, which eventually spore in the efflorescent manner described. Yet most silk-worm raisers, including such good authorities as E. F. Guérin-Méneville and Eugene Robert,* who at first implicitly believed in the fungus origin of this disease, now consider that the *Botrytis* is only the ultimate symptom—the termination of it. At the same time they freely admit that the disease may be contracted by the *Botrytis* spores coming in contact with worms predisposed by unfavorable conditions to their influence. Such a view implies the contradictory belief that the disease may or may not be the result of the fungus; and those who consider the fungus as the sole cause certainly have the advantage of consistency." Dr. Carpenter, of microscopic fame, believes in the fungus origin of the disease, and thinks it entirely caused by floating spores being carried in at the spiracles or breathing orifices of the worm and germinating in the interior of the body.

Whichever view be held, it appears very clear that no remedies are known, but that care in procuring good eggs, care in rearing the worms, good leaves, pure, even-temperatured atmosphere, and cleanliness, are checks to the disease. The drawers and other objects with which the diseased worms may have been in contact should be purified by fumigations of sulphurous acid (SO_2), produced by mixing bisulphite of soda with any strong acid, or, better still, by subjecting them to a carbolic-acid spray from an atomizer. In this way all fungus spores will be destroyed. In fact it will be well to wash off the trays or shelves once in a while with diluted carbolic acid, as a sure preventive. It is the best disinfectant known to science. The cheapest kinds may be used with the same efficacy as the more expensive.

Another disease, known as *pébrine*, has proved extremely fatal in Southern Europe, and for twenty years has almost paralyzed silk-culture in France. It is a disease which, in its nature and action, except in being hereditary, bears a striking analogy to cholera among men. "The worms affected by *pébrine* grow unequally, become languid, lose appetite, and often manifest discolored spots upon the skin. They die at all ages, but, as in *muscardine*, the mortality is greatest in the last age. The real nature of this malady was for a long time unknown. In 1849, M. Guérin-Méneville first noticed floating corpuscles in the bodies of the diseased worms. These corpuscles were supposed by him to be endowed with independent life, but their motion was afterwards shown by Filippi to depend on what is known as the Brownian motion, and they are now known either by the name of *panhistophyton*, first given them by Lebret, or by that of *psorospermiæ*. They fill the silk canals, invade the intestines, and spread throughout the tissues of the animal in all its different states; and though it was for a long time a mooted question as to whether they were the true cause or the mere result of the disease, the praiseworthy researches of Pasteur have demonstrated that *pèbrine* is entirely dependent upon the presence and multiplication of these corpuscles. He has analyzed the disease so clearly that not only do we see its nature, but are able to point out the remedy. The

*Guide à l'àléveur de vers e soie.

disease is both contagious and infectious, because the corpuscles which have been passed with the excrement or with other secretions of diseased worms have been taken into the alimentary canal of healthy ones in devouring the soiled leaves, and because it may be inoculated by wounds inflicted by the claws. It is hereditary on the mother's side, because the moth may have the germ of the disease and yet oviposit. Indeed, the eggs may be affected and yet look fair and good, the microscopic *psorospermiæ* not being visible, so that the only true test of disease or health is an examination of the parent moth; and by killing off all infected moths the disease can be controlled.

"Both the diseases mentioned are, therefore, in the strict sense of the word, silk-worm plagues; the one of a fungus and the other of an epizoötic nature. Each may become epidemic when the conditions are favorable for the undue multiplication of the minute organisms which produce them, or when the checks to the increase of such organisms are removed by carlessness or ignorance." Cleanliness and purification are absolutely necessary in treating both these diseases, and in *pébrine* care must be taken to see that the eggs are sound by a microscopic examination of the moths. This may be done after the eggs are laid, and if the corpuscles be found in the mother, her eggs should be discarded.

Silk-worms are subject to other diseases, but none of them have ever acquired the importance of those described. What is called *gattine* by older authors is but a mild phase of *pébrine*. The worms are apt to be purged by unwholesome leaves; too great heat makes them sickly; or they may become yellow, limp, and die of a malady called *grasserie* or jaundice, which is almost sure to appear in large broods, and which is very common in those reared in this country. When the worms die from being unable to molt they are called *lusettes*, and such cases are most abundant at the fourth molt. All these different ailments, and others not mentioned, have received names, some local, others more general; but none of them warrant further notice here, as they are not likely to become very troublesome if proper attention and care be given to the worms.

VARIETIES OR RACES.

As before stated, domestication has had the effect of producing numerous varieties of the silk-worm, every different climate into which it has been carried having produced either some changes in the quality of the silk, or the shape or color of the cocoons, or else altered the habits of the worm.

Some varieties produce but one brood in a year, no matter how the eggs are manipulated; such are known as *Annuals*. Others, known as *Bivoltins*, hatch twice in the course of the year; the first time, as with the Annuals, in April or May, and the second, eight or ten days after the eggs are laid by the first brood. The eggs of the second brood only are kept for the next year's crop, as those of the first brood always either hatch or die soon after being laid. The *Trevoltins* produce three annual generations. There are also *Quadrivoltins*, and, in Bengal, a variety known as *Dacey*, which is said to produce eight generations in the course of a year. Some varieties molt but three times instead of four, especially in warm countries and with Trevoltins. Experiments, taking into consideration the size of the cocoon, quality of silk, time occupied, hardiness, quantity of leaves required, etc., have proved the annuals to be more profitable than any of the polyvoltins, although Bivoltins are often reared; and Mr. Alfred Brewster, of San Gabriel, Cal., says that he found a green Japanese variety of these last more hardy than

the Chinese Annuals. Varieties are also known by the color of the cocoons they produce, as greens, or whites, or yellows, and also by the country in which they flourish. The white silk is the most valuable in commerce, but the races producing yellow, cream-colored, or flesh-colored cocoons are generally considered to be the most vigorous. No classification of varieties can be attempted, as individuals of the same breed exported to a dozen different localities would, in all probability, soon present a dozen varieties. The three most marked and noted European varieties are the Milanese (Italian) breed, producing fine small yellow cocoons; the Ardêche (French) producing large yellow cocoons, and the Brousse (Turkish) producing large white cocoons of the best quality in Europe. Owing to the fearful prevalence of *pébrine* among the French and Italian races for fifteen or twenty years back, the Japanese Annuals have come into favor. The eggs are bought at Yokohama in September, and shipped during the winter. There are two principal varieties in use, the one producing white and the other greenish cocoons, and known respectively as the white Japanese and the green Japanese Annuals. These cocoons are by no means large, but the pods are solid and firm, and yield an abundance of silk. They are about of a size, and both varieties are almost always constricted in the middle (Pl. II, Fig. 4, *c* green, *d* white). Another valuable race is the white Chinese Annual (Pl. II, Fig. 4, *e*), which much resembles the white Japanese, but is not as generally constricted. Plate II, Fig. 4, *a* and *b* represent, respectively, white and yellow French Annuals.

WINTERING AND HATCHING THE EGGS.

We have already seen the importance of getting healthy eggs, free from hereditary disease, and of good and valuable races. There is little danger of premature hatching until December, but from that time on, the eggs should be kept in a cool, dry room in tin boxes to prevent the ravages of rats and mice. They are most safely stored in a dry cellar, where the temperature rarely sinks below the freezing point, and they should be occasionally looked at to make sure that they are not affected by mold. If, at any time, mold be perceived upon them it should be at once rubbed or brushed off, and the atmosphere made drier. If the tin boxes be perforated on two sides and the perforations covered with fine wire gauze, the chances of injury will be reduced to a minimum.

The eggs may also, whether on cards or loose,* be tied up in small bags and hung to the ceiling of the cold room. The string of the bag should be passed through a bottle neck or a piece of tin to prevent injury from rats and mice. The temperature should never be allowed to rise above 40° F., but may be allowed to sink below freezing point without injury. Indeed, eggs sent from one country to another are usually packed in ice. They should be kept at a low temperature until the Mulberry leaves are well started in the spring, and great care must be taken as the weather grows warmer to prevent hatching before their food is ready for them, since both the Mulberry and Osage orange are rather late in leafing out. One great object should be, in fact, to have them all kept back, as the tendency in our climate is to premature hatching. Another object should be to have them hatch uniformly, and this is best attained by keeping together those laid at one and the same time, and by wintering them, as already recommended, in cellars that are cool enough to prevent any embryonic development. They should then, as

* For explanation see what follows under egg-laying.

soon as the leaves of their food-plant has commenced to put forth, be placed in trays and brought into a well-aired room where the temperature averages about 75° F. If they have been wintered adhering to the cloth on which they were laid, all that is necessary to do is to spread this same cloth over the bottom of a tray. If, on the contrary, they have been wintered in the loose condition, they must be uniformly sifted or spread over sheets of cloth or paper. The temperature should be kept uniform, and a small stove in the hatching-room will prove very valuable in providing this uniformity. The heat of the room may be increased about 2° each day, and if the eggs have been well kept back during the winter, they will begin to hatch under such treatment on the fifth or sixth day. By no means must the eggs be exposed to the sun's rays, which would kill them in a very short time. As the time of hatching approaches, the eggs grow lighter in color, and then the atmosphere must be kept moist artificially by sprinkling the floor, or otherwise, in order to enable the worms to eat through the egg-shell more easily. They also appear fresher and more vigorous with due amount of moisture.

FEEDING AND REARING THE WORMS.

The room in which the rearing is to be done should be so arranged that it can be thoroughly and easily ventilated, and warmed if desirable. A northeast exposure is the best, and buildings erected for the express purpose should, of course, combine these requisites. If but few worms are to be reared, all the operations can be performed in trays upon tables, but in large establishments the room is arranged with deep and numerous shelves, from 4 to 8 feet deep and 2 feet 6 inches apart. All wood, however, should be well seasoned, as green wood seems to be injurious to the health of the worms. When the eggs are about to hatch, mosquito-netting or perforated paper should be laid over them lightly. Upon this can be evenly spread freshly-plucked leaves or buds. The worms will rise through the meshes of the net or the holes in the paper and cluster upon the leaves, when the whole net can easily be moved. In this moving, paper has the advantage over the netting, in that it is stiffer and does not lump the worms together in the middle. They may now be spread upon the shelves or trays, care being taken to give them plenty of space, as they grow rapidly. Each day's hatching should be kept separate in order that the worms may be of a uniform size, and go through their different moltings or sicknesses with regularity and uniformity; and all eggs not hatched after the fourth day from the appearance of the first should be thrown away, as they will be found to contain inferior, weakly, or sickly worms. It is calculated that one ounce of eggs of a good race will produce 100 pounds of fresh cocoons; while for every additional ounce the percentage is reduced if the worms are all raised together, until for 20 ounces the average does not exceed 25 pounds of cocoons per ounce. Such is the general experience throughout France, according to Guérin-Méneville, and it shows the importance of keeping them in small broods, or of rearing on a moderate scale.

The young worms may be removed from place to place by means of a small camel's-hair brush, but should be handled as little as possible. The best mode of feeding and caring for them is by continuing the use of the feeding-net first mentioned. As the worms increase in size the net must have larger meshes, and if it should be used every time fresh food is furnished, it will save a large amount of time and care. It entirely obviates the necessity of handling the worms, and enables the person

having charge of them to keep them thoroughly clean; for, while they pass up through the net to take their fresh food, their excrement drops through it and is always taken up with the old litter beneath. It also acts as a detective of disease; for such worms as are injured, feeble, or sickly, usually fail to mount through the meshes and should be carried off and destroyed with the refuse in the old net below. This placing on of the new net and carrying away of the old is such a great convenience and time-saver that in France, for many years, paper stamped by machinery with holes of different sizes, suited to the different stages of the worms, has been used. The paper has the advantage of cheapness and stiffness, but a discussion as to the best material is unnecessary here, the aim being to enforce the principle of the progressive rise of the worms. Details will suggest themselves to the operator.

Where the nets are not used, there is an advantage in feeding the worms upon leaf-covered twigs and branches, because these last allow a free passage of air, and the leaves keep fresh a longer time than when plucked. In this feeding with branches consists the whole secret of the California system, so much praised and advocated by M. L. Prevost. The proper stamped paper not being easily obtained in this country, mosquito-netting will be found a very fair substitute while the worms are young, and when they are larger I have found thin slats of some non-resinous and well-seasoned wood, tacked in parallel lines to a frame just large enough to set in the trays, very serviceable and convenient—small square blocks of similar wood being used at the corners of the tray to support the frame while the worms are passing up through it. Coarse twine-netting stretched over a similar frame will answer the same purpose, but wire-netting is less useful, as the worms dislike the smooth metal.

Where branches, and not leaves, are fed, the Osage orange has the advantage of Mulberry, as its spines prevent too close settling or packing, and thus insure ventilation. It is recommended by many to feed the worms while in their first age, and consequently weak and tender, leaves that have been cut up or hashed, in order to give them more edges to eat upon and to make less work for them. This, however, is hardly necessary with Annuals, although it is quite generally practiced in France. With the second brood of Bivoltins it might be advisable, inasmuch as the leaves at the season of the year when they appear, have attained their full growth and are a little tough for the newly hatched individuals. In the spring, however, the leaves are small and tender, and nature has provided the young worms with sufficiently strong jaws to cut them.

Many rules have been laid down as to regularity of feeding, and much stress has been put upon it by some writers, most advising four meals a day at regular intervals, while a given number of meals between molts has also been urged; but such definite rules are of but little avail, as so much depends upon circumstances and conditions. The food should, in fact, be renewed whenever the leaves have been devoured, or whenever they have become in the least dry, which, of course, takes place much quicker when young and tender than when mature. This also is an objection to the use of the hashed leaves, as, of course, they would dry very quickly. The worms eat most freely early in the morning and late at night, and it would be well to renew the leaves abundantly between 5 and 6 a. m. and between 10 and 11 p. m. One or two additional meals should be given during the day, according as the worms may seem to need them. Great care should be taken to pick the leaves for the early morning meal the evening before, as when picked and fed with the dew

upon them they are more apt to induce disease. Indeed, the rule should be laid down, never feed wet or damp leaves to your worms. In case they are picked during a rain, they should be thoroughly dried before being fed; and on the approach of a storm it is always well to lay in a stock, which should be kept from heating by occasional stirring. Care should also be taken to spread the leaves evenly, so that all may feed alike. During this first and most delicate age the worm requires much care and watching.

As the fifth or sixth day approaches, signs of the first molt begin to be noticed. The worm begins to lose appetite and grow more shiny, and soon the dark spot already described appears above the head. Feeding should now cease, and the shelves or trays should be made as clean as possible. Some will undoubtedly undergo the shedding of the skin much more easily and quickly than others, but no feed should be given to these forward individuals until nearly all have completed the molt. This serves to keep the batch together, and the first ones will wait one or even two days without injury from want of food. It is, however, unnecessary to wait for all, as there will always be some few which remain sick after the great majority have cast their skins. These should either be set aside and kept separate, or destroyed, as they are usually the most feeble and most inclined to disease; otherwise, the batch will grow more and more irregular in their moltings and the diseased worms will contaminate the healthy ones. It is really doubtful whether the silk raised from these weak individuals will pay for the trouble of rearing them separately, and it will be better perhaps to destroy them. The importance of keeping each batch together, and of causing the worms to molt simultaneously, cannot be too much insisted upon as a means of saving time.

As soon as the great majority have molted they should be copiously fed, and, as they grow very rapidly after each molt, and as they must always be allowed plenty of room, it will probably become necessary to divide the batch, and this is readily done at any meal by removing the net when about half of the worms have risen and replacing it by an additional one. The space allotted to each batch should, of course, be increased proportionately with the growth of the worms. The same precautions should be observed in the three succeeding molts as in this first one.

As regards the temperature of the rearing-room, great care should be taken to avoid all sudden changes from warm to cold, or *vice versa*. A mean temperature of 75° or 80° F. will usually bring the worms to the spinning-point in the course of 35 days after hatching, but the rapidity of development depends upon a variety of other causes, such as quality of leaf, race of worm, &c. If it can be prevented, the temperature should not be permitted to rise very much above 80°, and it is for this reason that a room with a northern or northeastern exposure was recommended as preferable to any other. The air should be kept pure all of the time, and arrangements should be made to secure a good circulation. Great care should be taken to guard against the incursions of ants and other predaceous insects, which would make sad havoc among the worms were they allowed an entrance; and all through the existence of the insect, from the egg to the moth, rats and mice are on the watch for a chance to get at them, and are to be feared almost as much as any other enemy the silk-worm has.

The second and third casting of the skin take place with but little more difficulty than the first, but the fourth is more laborious, and the worms not only take more time in undergoing it, but more often perish

in the act. At this molt it is perhaps better to give the more forward individuals a light feed as soon as they have completed the change, inasmuch as it is the last molt and but little is to be gained by the retardation, whereas it is important to feed them all that they will eat, since much of the nutriment given during the last age goes for the elaboration of the silk. At each successive molt the color of the worm has been gradually whitening, until it is now of a decided cream color. Some breeds, however, remain dark, and occasionally there is an individual with zebra-like markings. During these last few days the worms require the greatest care and attention. All excrement and litter must be often removed, and the sickly and diseased ones watched for and removed from the rest. The quantity of leaves which they devour in this fifth age is something enormous, and the feeding will keep the attendant busily employed.

Summed up, the requisites to successful silk-worm raising are: 1st. Uniformity of age in the individuals of the same tray, so as to insure their molting simultaneously. 2d. No intermission in the supply of fresh food, except during the molting periods. 3d. Plenty of room so that the worms may not too closely crowd each other. 4th. Fresh air and as uniform temperature as possible. 5th. Cleanliness. The last three are particularly necessary during the fourth and fifth ages. While small, the frass, dung, and detritus dry rapidly, and may (though they should not) be left for several days in a tray with impunity, but he who allows his trays to go uncleaned far more than a day during the ages mentioned will suffer in the disease and mortality of his worms just as they are reaching the spinning-point.

PREPARATION FOR SPINNING.

With eight or ten days of busy feeding, after the last molt, the worms, as we have learned before, will begin to lose appetite, shrink in size, become restless, and throw out silk, and the arches for the spinning of the cocoons must now be prepared. These can be made of twigs of different trees, two or three feet long, set up upon the shelves over the worms, and made to interlock in the form of an arch above them. Interlace these twigs with broom-corn, hemlock, or other well-dried brush. The feet of each arch should be only about a foot apart. The temperature of the room should now be kept above 80°, as the silk does not flow so freely in a cool atmosphere. The worms will immediately mount into the branches and commence to spin their cocoons. They will not all, however, mount at the same time, and those which are more tardy should be fed often, but in small quantities at a time, in order to economize the leaves, as almost every moment some few will quit and mount. There will always be a few which altogether fail to mount, and prefer to spin in their trays. It is best, therefore, after the bulk have mounted, to remove the trays and lay brush carefully over them. The fact that the worms already mounted make a final discharge of soft and semi-fluid excrement before beginning to spin makes this separation necessary, as otherwise the cocoons of the lower ones would be badly soiled. As the worms begin to spin they should be carefully watched, to guard against two or three of them making what is called a double or treble cocoon, which would be unfit for reeling purposes. Whenever one worm is about to spin up too near another, it should be carefully removed to another part of the arch. In two or three days the spinning will have been completed, and in six or seven the chrysalis will be formed.

GATHERING THE COCOONS.

Eight days from the time the spinning commenced it will be time to gather the cocoons. The arches should be carefully taken apart, and the spotted or stained cocoons first removed and laid aside. Care should be taken not to stain the clean ones with the black fluids of such worms as may have died and become putrid, for there are always a few of these in every cocoonery. The outer cocoons of loose or floss silk are then torn from the inner cocoons or pods, and the latter separated according to color, weight and firmness of texture; those which best resist pressure indicating that the worm has best accomplished its work. Too much care cannot be taken to remove the soft or imperfect cocoons, as if mixed with the firm ones, they would be crushed and soil the others with their contents. The very best of the firm cocoons are now to be chosen as seed for the next year, unless the raiser prefers buying his eggs to the trouble of caring for the moths and keeping the eggs through the winter. Eggs bought from large establishments are, however, apt to be untrustworthy, and it is well for all silk-raisers to provide their own seed. These cocoons should be chosen for their firmness, and the fineness and color of the silk, rather than for their size. Mr. Crozier says: "If white, take them of the purest white, neither soft nor satin-like; if yellow, give the preference to the straw-colored, which are the most sought after; and, last, if they are the green of Japan, the greener they are, of a dark, sharp color, very glossy, the better is the quality of the thread. Discard the pale shades in the last breed." If there are any double or treble cocoons in the batch, of the right color, quality, and consistency, they should be used before the others, as they are just as good for breeding purposes, though unfit for reeling. In estimating the quantity that will be required, the following figures will be of use: The general estimate is always made of 40,000 eggs to the ounce, and also that each female lays from 300 to 400 eggs. Taking the higher estimate, it will require only 100 females to lay an ounce of eggs; taking the lower, it will require 133. It will, therefore, not be safe to take fewer than 200 cocoons, half males and half females, if an ounce of seed is desired, and from that to 225 would be safer. While it may not always be possible to determine the sex of the cocoons by their shape, we may approximately separate them by weighing. The whole quantity set aside for breeding purposes is first weighed in order to get the average, and then each one is weighed separately, and all above the average may be pretty accurately considered females and all below it males. These breeding cocoons should now be either pasted upon card-board on their sides, or strung upon a string, great care being taken to run the needle through the silk only and not deep enough to injure the chrysalis, the object being in both cases to secure the cocoon so that the moth can the more readily make its escape. They can be laid aside in a rat-proof place to await the appearance of the moths, and in the mean time the other cocoons should be taken care of.

CHOKING THE CHRYSALIS.

In most silk-producing countries the parties who raise the cocoons sell them to the reeling establishments before suffocation is necessary, as these establishments have better facilities for this work than are to be found in private families. If, however, the reeling is done by the raiser, or some time must elapse before the cocoons can be sent to a reeling establishment, some means must be used to kill the contained chrysalis

before the cocoon is injured for reeling purposes by the egress of the moth. This can be done by stifling them with steam or choking them by dry heat. Steaming is the surest, quickest, and best method, if the facilities are at hand: it can be done at any steam mill. The cocoons are laid upon shelves in a tightly sealed box and the steam is turned in. Twenty minutes will suffice to do the required work, and the cocoons are then dried in the sun. The dry-heat method occupies a much longer time. The cocoons are placed in shallow baskets and slipped on iron drawers into an oven which is kept heated to a temperature of about 200° Fah. This should not be increased for fear of burning the silk. This operation lasts from two to twenty-four hours. A certain humming noise continues so long as there is any life, and its cessation is an indication that the chrysalides are all dead. Where the choking is well done there is little loss, only about one per cent. of the cocoons bursting at the ends. After choking in this manner, the cocoons should be strewn upon long wooden shelves, in the shade, with plenty of air, and, for the first few days, frequently stirred. After remaining on these shelves for about two months, with occasional stirrings, the chrysalides become quite dry and the cocoons will preserve indefinitely. They are, however, still subject to the attacks of rats and mice, and the little beetles known as "museum pests," belonging to the genera *Dermestes* and *Anthrenus*, are attracted by the dead chrysalis within and will penetrate the cocoon, injuring it for reeling purposes. In the warm Southern States the dry-heat choking can be accomplished by simple exposure to the sun. This was done by M. L. Prevost in Southern California, and is practised habitually by Mr. Crozier in Silkville, Kans., who says: "Here the cocoons need only to be fully exposed to the rays of the sun, from nine o'clock in the morning until four o'clock in the afternoon. Two or three days of such exposure are sufficient. But, as sometimes strong wind can annihilate the effect of the sun's warmth, it is good to have for that purpose long boxes, 4 feet wide, sides 6 inches high, to be covered with glass frames. This will increase the heat, and by absorbing the air of the box, stifle your chrysalis most surely." Ed. Müller, another California grower (Nevada County), always makes use of this method of stifling by the sun's rays, but says that a crack the glass cover of the box should be left open to allow the evaporation of the moisture, which otherwise would collect in large drops upon the glass, and, falling back upon the cocoons, would keep them moist for a longer time. Do not, however, allow the ants to creep in at the crack, as they, too, will penetrate the cocoon to feed upon the chrysalis.

In the colder climates it has been suggested that the chrysalis could be well choked, with no injury to the cocoons, by placing them in a vacuum box and exhausting the air. Chloroform has been used to a certain extent, and experiments are now being made in France with sulph-hydric acid gas, a vapor which is evolved from the mixture of dilute sulphuric acid and sulphide of iron; also, with bisulphide of carbon.

EGG LAYING—REPRODUCTION.

In from twelve to twenty days from the time when the worm commenced to spin, the moths will begin to issue from the cocoons laid aside for breeding purposes. They issue most abundantly during the early morning hours, from four to eight o'clock, and as they appear they should be taken by the wings and the sexes kept apart for a short time. The males may be readily distinguished from the females

by their broader antennæ and smaller bodies, as also by the incessant fluttering of their wings. The females remain comparatively quiet, their abdomens being heavy and distended with eggs. A few hours after issuing, the sexes, in equal numbers, may be placed together, great care having been taken to destroy any that are at all deformed, in order to keep the breed as fine as possible. They should be placed upon paper or card-board, and the room should be kept as dark as possible in order that the males shall not uncouple themselves. For the complete impregnation of the eggs, the sexes should be kept together six hours, neither more nor less, and occasionally visited in order to replace those males which may have become separated. Should there, on this day, more males than females issue, the superfluous males may be put in a closed box and kept till the next day, when the state of things may be reversed. Should there, on the other hand, be a superfluity of females, a sufficient number of the strongest and most vigorous males should be uncoupled at 4 hours and placed with the unpaired females for 6 hours more. As the pairs are uncoupled at the end of 6 hours, care should be taken to injure neither sex. The female should be held by the wings with one hand and the abdomen of the male gently pressed with the other. The males may then be laid aside in a box, as there may be use for them before all the moths have appeared. After all the females are impregnated, however, their mates may be thrown away. The females, as soon as separated, should be placed for a few minutes upon sheets of blotting-paper, where they will free themselves of a quantity of greenish-yellow fluid. From the blotting-paper they should be transferred to trays lined with cloth upon which the eggs are to be laid. This cloth should be of the smoothest sort of woollen stuff rather than of linen or paper, if it is desired to remove the eggs at a future time, as they will stick so fast to the latter that it will be difficult to remove without bruising them. Upon these trays they may be placed in rows, and will immediately commence depositing. It is advisable to tip up the trays at one end so that they incline a little, as the moths are then more apt to lay their eggs uniformly. They should also be kept in the dark, in accordance with the nocturnal habit of the moth. The temperature of the room should be kept at about 75°, and plenty of air given during oviposition. All of the thoroughly impregnated eggs will be laid in about 24 hours, and the moth should be removed after that length of time. She may continue depositing a short time longer, but the eggs should be kept by themselves and not mixed with the others. It will be well, also, if the best and purest breed be desired, to keep the eggs of those moths which were coupled with males that had been used before separated from the eggs laid by those which were coupled with virgin males. "The eggs are best preserved on the cloth where originally deposited, as they are protected by a natural coating of varnish, and, being fastened, the worms, when hatching, eat their way out better. For commercial purposes, however, they are usually detached during the winter by immersing the cloth containing them in cool soft water for a few moments; the moisture being then drained off by means of blotting-paper and the eggs gently removed with a paper-knife. They are then washed in soft water, thoroughly dried, and put away for keeping. All eggs which swim on the surface are considered bad and discarded. The Japanese producers sell their eggs on cards or cartoons made of coarse silk. The cards are placed in wooden frames, the rims of which are varnished, so that the moths—disliking the varnish—are made to confine their eggs upon the cards, which are consequently covered in a very regular and uniform manner."

The egg retains the characteristic color of the unimpregnated ones—

light yellow—for 12 or 15 days, when it gradually acquires the gray, lavender, or greenish tint of impregnation. The moths live but a few days after having perpetuated their kind.

REELING.

"If the mere rearing of the worm and the production of the cocoons is simple, the reeling of the silk is by no means so, as the greatest skill is required to accomplish the work properly, and the value of a hank of silk depends as much on the skill of the reeler as upon the quality of the original thread. In the best cocoons the silk will measure upwards of a thousand feet in length, and, though it appears single, it is in reality composed of two threads, which are glued together and covered as they issue from the spinneret of the moth with a glossy varnish, which enables the worm to fasten the silk where it wills, and which is soluble in warm water."

In countries where there are steam-reeling establishments, it is generally more profitable for the small raiser to sell his cocoons, and not go to the trouble and expense of reeling by hand; but, unfortunately, there is no market for choked cocoons in this country, and the raiser will be under the necessity of reeling his own silk if he wishes to make the most of them. It will be desirable, then, in this paper, to state the facts and principles which should govern the unwinding and reeling, for the benefit of those who may wish to use single basins and reels worked by hand. In the great reeling districts of France, everything is brought to such perfection in the *filatures*, or reeling establishments, by the aid of steam, that the hand-reels have there almost gone out of use. But most of the silk is unwound by hand-power in China, and excellent silk may be made by dexterous management with a good hand-reel.

"Raw silk is classified into organzine, tram, and floss. Organzine is considerably twisted and is the choicest. Tram is made from inferior cocoons and is but slightly twisted. Floss is made of the loose silk, carded and spun like cotton or wool.

"The thread of silk as it unwinds from the cocoon is valueless for manufacturing purposes, several of them combined going to make the staple of commerce. The persons employed in unwinding silk are mostly women, one standing or sitting before each basin, of which she has entire charge. The basin is made of copper, and, in the large establishments, the water in each basin is heated by steam, at the control of the operator. The cocoons are plunged into the water, when it is near the boiling point, and moved about so that the gum which fastens the threads becomes uniformly and thoroughly softened. They are then beaten with a small birchen broom, having the tips split, so that the loose threads readily fasten to them. After beating a short time, the operator gets all the cocoons fastened, and, taking the bundle of threads, shakes the cocoons till each hangs but by a single one. She now takes up five or more threads (*brins*), according to the quality of silk wanted, unites them, and introduces the combined staple or strand (*fil*) into a little glass eye on one side of the basin. She then forms a second similar strand and introduces it into a second eye on the other side. The strands are then brought together, twisted several times, separated above the twist, and introduced into two other glass eyes or ringlets through which they are led, one to each end of the reel or *tambour*, which is kept revolving in a steady, rapid manner, and to which is also given a certain back-and-forth side motion. The great object in reeling is to get the threads uniform, rounded, well joined, properly freed from moisture, and so crossed

on the reel that they will not stick or glaze, as it is termed. These objects are attained by the twisting and the to-and-fro lateral movement of the reel, as also by properly regulating the distance between reel and basin. The uniformity of the thread depends on the skill of the operator, who must supply a new thread as soon as one begins to give out. This is called nourishing the silk, and is done by dexterously casting, with the thumb, the new thread upon the combined strand, to which it immediately adheres. In this she must use much judgment, for the silk of a cocoon gradually gets lighter and finer as it approaches the end, and the uniformity of strand does not entirely depend on the uniformity in number of the individual threads forming it. Whenever the silk rises in locks the temperature of the water is known to be too hot, and when it unwinds with difficulty the temperature is, on the contrary, too low. The operator is supplied with a skimmer with which to remove all chrysalides and refuse silk; also, with a basin of cold water in which to cool her fingers, which are being constantly dipped in the hot basin. This constitutes the whole operation of unwinding, but before the skeins, as they come from the reel, are ready for the manufacturer they must undergo still further manipulation. The staple is first passed through a cleanser, consisting of a clasp lined with cloth, which catches any loose silk or other matter that may be adhering to it. It is then further cleansed and purged by being passed through four similar cleansers (*purgeurs*), then twisted about 500 times to the yard, then doubled and again twisted about 400 times to the yard. It is finally run on to reels about 1½ feet in diameter, and taken off and twisted in a peculiar knot or hank. Through all these operations the oscillating to-and-fro lateral motion is kept up, so as to produce the diagonal crossing of the strands, and it will be readily understood that each staple is, in the end, composed of ten or more of the simple threads first spun by the worm.

"The loose or flock silk, together with all which, from one cause or another, cannot be reeled, is soaked in water for three days, boiled for one-half hour in clear lye, washed in rain-water, and when dry, carded, and spun, it makes an inferior floss silk."

In order to better illustrate these principles, we have introduced figures of three reels. Pl. I, Fig. 4, is the old Piedmontese reel, which for many years held its supremacy, and which has been the foundation of numerous improved reels. It is formed of four bars or arms, and is usually about a yard in circumference. One of these bars is provided with hinges so that it may fold inwards towards the center when it becomes necessary to slacken the silk in order to carefully remove it from the reel. The lateral movements so necessary in order that the consecutive circles shall not stick together is gained in rather a clumsy manner by means of cogs. The strands, after being twisted several times at *c*, in order to round and smooth the threads by friction, are passed over the guides *b b*, which are inserted in the traversing bar *a*. To this bar the lateral movement is imparted by a pin connected with the outer circumference of the cog-wheel *d*. This is connected at *e* with the cog revolving with the shaft of the reel. *f* represents a charcoal-furnace under the copper basin *g*. The cross-bar *h*, to which are attached the glass eyes through which the threads from the cocoons first pass, is usually widened into a shelf, upon which to place the broom and the cold water for the reeler's fingers.

Pl. I, Fig. 5, and Pl. II, Fig. 1, represent, respectively, a plane view, seen from above, and a longitudinal vertical section of an old French reel, differing somewhat from the Piedmontese, and the principles of which are employed in all the improved reeling establishments of to-day.

a. The oblong water-basin heated by a charcoal-furnace or by steam, and frequently divided by partitions.

b b. Hooked wires or eyelets to guide several threads and keep them apart.

c c. Points where the threads are twisted upon each other to clean their surfaces and compactly round them.

d. Cylinder on shaft, with a spiral groove in its surface, in which fits a pin from the traversing-bar, thus giving the lateral movement to the thread which goes through a guider on the front end of the bar, which moves through the arc of a circle.

e. The reel.

f. Pulleys which transmit by a belt the rotary motion of the cylinder *d* to the reel *e*, that connected with the reel being the smaller of the two.

g. Friction lever, for tightening or slackening the endless cord, in setting or stopping the winding operation. There is usually a series of such reels in one apartment, driven by the same motive power, but each of them, as has been shown, can be stopped at pleasure. In case the reels are driven by a steam-engine, stopcocks and pipes are so arranged that the water in every basin can be instantly or gradually heated by steam If desired to run the reel by hand, a handle can be placed upon the shaft of the cylinder *d*, or of the reel *e*.

Pl. II, Fig. 2, represents a hand-reel, of much the same style as the last, set up and ready for work. This machine was illustrated in the American Artisan for February, 1874, in the course of an article by W. V. Andrews, of Brooklyn. It is as good a hand-reel as is now in use, though it is made on the same principle as the old French reel of forty years ago.

a. Tin basin with copper bottom for holding the water in which the cocoons are boiled, fitting tightly over the tray *b*.

b. Square tin tray for reception of cocoons, &c.

c. Short stick inserted in a holder, on which the ends of the cocoons are wound, so as to be ready for use.

e. Cock to let off water from the basin. This should be done every night after use.

f. Door of furnace lined with fire-bricks, wherein the charcoal fire is lighted to heat the water in *a*.

g. Flue-pipe to carry off fumes; this, as supplied, is short; the length and direction in which it may be carried varying in every case. It is necessary that all the charcoal fumes should be carried either into a chimney or into the open air.

hh. Glass eyes on wire holders, through which the threads from the cocoons pass upward to the pulleys at *k*. It is of importance that the glass eyes should be so placed that the threads pass upward in a straight line from the water to the pulleys at *k*, and also from the pulleys to the top of the wheel at *o* (except so far as when diverted laterally by the long guider at *ll*); friction is thus reduced to a minimum, and the elasticity of the thread preserved.

i. A former arrangement for twisting the threads one upon the other; this is now discontinued as unnecessary, since the twist given to the threads at *k* and continued downward to the point *h* effects its purpose with a minimum of friction, and produces a superior thread. This twist is effected by the very simple method of passing one thread round the other, as shown in the small drawing of the pulley *k*.

kk. Rollers or pulleys revolving on bent-wire stands, over which the threads pass.

ll. Porcelain tubes on wire holders, between which the threads pass to reach *o.* Glass eyes may be substituted for the first pair of these tubes with equal advantage.

nn. A grooved arrangement by means of which the long guider working to and fro distributes the thread to the reel "in the cross." Unless the thread is thus wound "on the cross," it cannot be unwound at the mills when required to be thrown, and is, therefore, unsalable.

o. The top of the reel on which the silk is wound. One of the arms is furnished with the screw-hinge attached, by means of which the length of the arm is diminished to take off the silk.

p. Handle of the machine. (The letter in the cut is in the wrong place.)

The adult reeler sits on the stool in front of the cocoons, and the other stool is occupied by the child who turns the crank.

FOOD PLANTS.

The traditional food plant of the silk-worm is the Mulberry (botanical genus *Morus*). There are two species of Mulberry indigenous to the United States, namely, the Red Mulberry (*Morus rubra*) and the Small-leaved Mulberry (*Morus parvifolia*), neither of which is suitable silk-worm food. I have tried in vain to rear the worms upon *rubra*, but they either refuse its leaves entirely or dwindle and soon die upon it. The imported species which are most used are the white (*M. alba*), the *Multicaulis*, and the black (*M. nigra*). This last is inferior to the other two as silk-worm food.

The mulberry grows readily, being easily propagated by cuttings or layers or from the seed. The white mulberry, in particular, grows well from cuttings, and this is perhaps the readiest and most economical method of planting to secure a stock.

The cuttings should be started in rows, 3 or 4 inches apart, in ground prepared by deep plowing and harrowing. They should be about 6 inches long, and should be cut just before an eye in every case. They should be almost entirely buried. The quickest way to get a supply of leaves is to grow dwarfs. Set out the young trees from the nursery in rows 10 to 15 feet apart, and 6 to 8 feet between the rows, and form the crown of the tree by cutting down to a foot or so from the ground. The height of the tree and its form are easily regulated by pruning, and upon this process depend not only the vigorous growth of the tree, but also the ease with which the leaves may be gathered when desired. The pruning may be done in February or March, either every year or every other year. All dead twigs and dried bark should be removed and the limbs kept as smooth as possible, as this greatly facilitates picking. The best time for planting is in the fall, from frost until December, and in the spring, from March until May.

For growing standard high trees, a practical raiser gives the following directions: The cutting should remain two years in the nursery without pruning. The third year it is cut down close to the ground and transplanted. The finest shoot is then allowed to grow, and in good land it will reach a height of 8 or 10 feet in one season. The fourth year it is cut back to 6 feet or thereabouts. Then, the three or four terminal buds only being allowed to grow, all others are removed as often as they appear by passing the hand along the stem.

The *Moretti*, a variety of the White Mulberry, is profitably grown in the form of a hedge, and the large size of its leaves makes it a very desirable variety.

OSAGE ORANGE.—The cultivation of the Osage orange (*Maclura aurantiaca*) is so well understood in this country that there is no need of giving detailed instructions on the subject. Very generally used as a hedge plant in those sections of the country which are particularly adapted to silk-culture, its leaves may at once be obtained without any special investment of capital. Indeed, as the hedges need trimming, the cutting off of the new year's growth, as the leaves may be wanted for feeding purposes, is a saving rather than an expenditure. Those who use this plant as silk-worm food must, however, bear in mind that the shoots from a hedgerow become very vigorous and succulent by the time the worms are in the last age. These more milky and succulent terminal leaves should be thrown aside and not used, as they are apt to induce flaccidity and disease.

In avoiding these more tender leaves, and using only the older and firmer ones, especially when the worms are large, consists the whole secret of the successful rearing of silk-worms on this plant; and if care be had in this respect there will be no appreciable difference in the silk crop from Osage orange as compared with that from Mulberry.

Should the worms, from whatever cause, hatch before either Mulberry or Osage orange leaves can be obtained, they may be quite successfully fed, for a few days, upon well-dried lettuce leaves. It will, however, be worse than a waste of time to attempt to feed them entirely on these leaves, or, in fact, on any other plants than the two here recommended.

GLOSSARY OF TERMS USED.

Age. The interval between any two molts.

Alimentary canal. The food canal; a straight, simple tube, running from one end of the body to the other, and which it is impossible to subdivide into gullet, stomach, and intestine.

Alkaline. Having the opposite reactions to an acid.

Anal horn. The horn upon the posterior end of the body of the worm.

Annuals. Those races which produce but one brood in a year.

Antennæ. The feathery feelers upon the head of the moth.

Bivoltins. Those races producing two broods in one year.

Bombycidæ. The family of moths commonly known as "spinners," to which the silk-worm moth belongs.

Botrytis Bassiana. The fungus causing muscardine.

Brin. The French term for a single thread from the cocoon.

Carneous. Flesh-colored.

Choked cocoons. A term applied to those cocoons in which the chrysalis has been killed.

Chrysalis. The third or restful stage of the insect, or that between the worm and the moth; inclosed in the cocoon.

Cocoon. The silken covering with which the worm surrounds itself before passing into the chrysalis state.

Cocoonery. The name applied to a room or building used for the spinning of worms.

Dacey. A Bengalese race of worms producing eight broods each year.

Dorsal vessel. The heart, extending from one end of the body to the other, just under the skin of the back.

Epizoötic. A term having the same significance with lower animals as *epidemic* with man.

Fil. A French term for the combined threads as they come from the reel.

Filature. The French name for a reeling establishment.

Floss silk. Raw silk made from the loose material of the outer cocoon and from pierced cocoons, &c. It is carded and spun like cotton or wool.

Gattine. An old name for a mild phase of the disease known as *pébrine*.

Grasserie. A silk-worm disease allied to jaundice.

Green cocoons. A name frequently applied to fresh or unchoked cocoons. Should be avoided, except where it has reference to cocoons of a green color.

Greens. A name applied to those races making cocoons of a greenish tint.

Integument. Skin or outer covering.

Labium. The under lip upon which is situated the spinneret.

Larva. The second or worm stage of the insect.

Lepidoptera. Name of the Order to which the silk-worm belongs.

Lusettes. A name applied to the worms which die from being unable to molt.
Magnanerie. Cocoonery.
Moretti. A variety of the White Mulberry discovered in 1815 by Professor Moretti, of Pavia.
Mori. The scientific specific name for the silk-worm.
Morus. The botanical generic name of the Mulberry.
Multicaulis. A species of *Morus* often called the Chinese Mulberry.
Muscardine. A silk-worm disease of a fungous nature, characterized in the text.
Spinneret. A tube projecting from the lower lip and through which the silk issues.
Organzine. The choicest kind of raw silk, made from the best cocoons, and considerably twisted.
Ovipositing. Laying the eggs.
Panhistophyton. Name given by Lebret to the floating corpuscles in the bodies of worms affected by *pébrine.*
Pébrine. A silk-worm disease characterized in the text.
Pod. The compact portion of the cocoon which is used for reeling purposes.
Polyvoltins. A term applied indiscriminately to all races which produce more than one brood in a year.
Prolegs. The ten non-jointed legs under the sixth, seventh, eighth, ninth, and last joints of the body of the worm.
Psorospermiæ. Ordinary name for the floating corpuscles in the bodies of worms affected by *pébrine.*
Purgeur. The French word for *cleanser*—a clasp lined with cloth, through which the skeins of raw silk are passed to remove loose silk and foreign particles.
Quadrivoltins. Those races which produce four broods in one year.
Raw silk. Silk reeled from the cocoons before being spun and woven.
Seed. The eggs in bulk.
Sericaria. A generic name proposed by Latreille, and to which the silk-worm is referred by modern writers.
Sickness. The period of molting.
Spiracles. The breathing-holes of the insect; one row of nine down each side of the body.
Spores. The germinating seed of fungi.
Tambour. The French for *reel.*
Tram. Raw silk reeled from inferior cocoons and but slightly twisted.
Transformation. The change from one state to another, as from worm to chrysalis or from chrysalis to moth.
Trevoltins. Those races of silk-worms of which there are three broods in one year.
Whites. Those varieties having white cocoons.
Yellows. Those varieties having yellow cocoons.

THE GRAPE PHYLLOXERA.

Various experiments and observations respecting this insect have been made by me during the year, but require further time for completion.

The fact that about 280 tons of California grapes were received weekly and sold in the markets of Philadelphia during the past season is sufficient to show that the grape-interest in this country is increasing in importance, and to lead to the hope that the discouragement which grape-growers in the Mississippi Valley must feel after four consecutive unfavorable seasons must needs soon give way before brighter prospects, that, it seems to me, are necessarily in store for them. One thing is sure, namely, that the interest manifested abroad in our American grape-vines does not flag. These vines are constantly discussed in the foreign horticultural journals, while one periodical, *La Vigne Americaine* (The American Vine), is entirely devoted to them. It is a source of satisfaction to me that the varieties which I first recommended, seven years ago, are, in the main, those still sought for and used by the French sufferers from Phylloxera, as stock on which to graft their *viniferas.* It is further interesting to observe that the grounds which I took in regard to grafting above ground (in the 7th Missouri Report, pp. 108–116); are justified by the experience had during the last few years in France. Such grafting is found to be quite practicable, notwithstanding the want

of faith shown in it by our earlier ampelographers. The fears which I expressed in the same report as to the danger of the introduction and spread of the Phylloxera in California have also been more than justified, since many vineyards have already been seriously injured or totally destroyed by the insect. I am glad to be able to confirm in this connection the truth of the statement of Mr. P. J. Berckmans, of Augusta, Ga., namely, that this insect does not occur in that locality. While spending a few days with him last September I was able to verify its non-occurrence there; and here let me remark that, however much contempt there may be for the Scuppernong, no one can witness the prolificacy or experience the delicacy and sweetness of such varieties as Tender-pulp and Thomas, as they grow in Georgia, without having a due appreciation of their value for the Southern States.

Regarding the range of Phylloxera, it had often been asserted that around Washington the root insect was not to be found; yet I have found it extremely abundant, both in the vineyards of the district and of those just across the line in Virginia, some of the latter suffering to such an extent that the whole crop was a failure, though the owners were unsuspicious of the cause.

After reviewing in the 8th Missouri Report all that was then known of the habits and natural history of the grape Phylloxera, I drew certain practical conclusions to the effect that complete knowledge of its habits, instead of simplifying its destruction, showed that it was almost if not quite hopeless to expect its destruction by any possible or practicable means, and rendered preventive measures all the more urgent. I expressed my doubt as to the value of decortication of the vines, and the burning of the bark in winter, or any means which aimed at the killing of the winter egg upon the branches and canes of the vines. Diligent search had failed to reveal these winter eggs in anything like the quantity one might expect, and the fact remained that the insect could go on propagating under ground for at least four years without the necessary intervention of the impregnated egg. Further research made since confirms me in the belief that the normal mode of hibernation of the species is as a young larva upon roots. From the results of the deliberations of the International Phylloxera Congress, held in 1877 at Lausanne, as well as from those held in 1878 at Berne and Montpellier, it was conclusively proved that decortication, as I had anticipated, was of little or no avail.

NOTES ON THE APPLE-WORM.

Mr. J. Savage, of Lawrence, Kans., in a recent number of Colman's *Rural World*, remarks upon the freedom of Michigan apples from the work of the Apple-worm (*Carpocapsa pomonella*). This same freedom was generally noticed in 1878, not only in Michigan but in many parts of New York, and it doubtless obtained elsewhere. It will be well for us to endeavor to arrive at the reasons. To my mind the following, first urged by me in the New York *Tribune*, may very properly be given: 1st. The very general failure of the apple crop in 1877, as exemplified in the reports for that year, which we find both in the proceedings of the Michigan Pomological Society and in those of the American Pomological Society. This failure was in many localities so nearly total that scarcely any apples were grown, and it follows as a consequence that very few codling moths were produced to perpetuate the species the following year. A second reason, so far as Michigan is concerned, may be found in the fact that in no State in the Union have more intelligent

and persevering efforts been made to prevent its ravages. Through the columns of the agricultural and horticultural journals, as well as in the pages of their pomological transactions, the simple methods of fighting this pest that have been reported and recommended in the Missouri Reports have been persistently kept before the people, while Professor Beal, of the Agricultural College, has, perhaps, done more good than any one else by showing that it cost him no more than 4 cents per tree to keep the bands around the trunks, changing them every nine days in the warm months, from the first appearance of the worms until the end of August, in an orchard of 250 trees. I agree with him when he asserts that "if a man will not take the trouble to keep his fruit from the worms he deserves to eat wormy apples"

Since my connection with the Department of Agriculture there have been sent to me four different kinds of patent bandages to be used as traps for this apple-worm, but I can find no advantages in any of them over the simple paper bandages, first recommended by me in 1872, and since very generally employed.

THE WESTWARD PROGRESS OF THE IMPORTED CABBAGE-WORM.

In 1869, in my second Missouri report, in treating of this insect, I remarked, "There is every reason to fear that it may some day get a foothold in our midst," after showing that it was then confined to certain restricted parts of Canada and New England, and had not spread west of New York. It has been making further progress westward every season since. The past year it has done considerable damage as far west as Chicago, and I have also received good testimony that it was observed around Saint Louis. I have given my reasons, in the report referred to, for believing that it will prove more disastrous to the cabbage fields around Saint Louis than the southern cabbage worm (*Pieris protodice*), which has always been with us and has done, at times, considerable damage; and I refer those who wish to be prepared with a full knowledge of the habits of this species to that same report.

As remedies, few liquids will prove more effectual than hot water, judiciously applied, though 1 pound of whale-oil soap, dissolved in about 6 gallons of water, or even a strong tar water, may be used to advantage. The application should be made several times during the year, as it will be most effectual when the worms are young.

As preventive measures, the worms may be induced to transform under flat pieces of board laid upon any object that will raise them about an inch from the surface of the ground. These boards should be examined every week and the transforming larvæ or the chrysalides destroyed. The butterflies may also be captured by hand-nets and prevented from laying their eggs.

CHAPIN'S APPLE-LEAF-SEWER.

(*Phoxopteris nubeculana*, Clem.)

[Ord. LEPIDOPTERA; Fam. TORTRICIDÆ.]

In March, 1877, I received from Mr. O. C. Chapin, of East Bloomfield, Ontario County, New York, a quantity of folded apple leaves, each leaf containing a small, greenish-yellow larva about 9 millimeters in length.

In the accompanying letter, Mr. Chapin stated that these insects had been noticed in his locality for three years, and seemed to be rapidly increasing. In 1876 the trees were seriously injured, one-fourth of the leaves in a part of his orchard containing the insects. He had noticed them in many orchards, and felt sure that they extended over considerable territory. The latter part of the same month specimens were received from Prof. J. H. Comstock, of Cornell University, with the remark that it was common in orchards in some parts of the State of New York.

Early in April the larvæ began to change to chrysalides, and after about ten days of chrysalis life, moths began to appear, and they continued to issue until the middle of May. At this time Mr. Chapin wrote that the moths were very abundant in his orchard upon the trunks and leaves of the trees.

Although the eggs have not as yet been observed, they are probably laid upon the leaves, the young larva hatching out in the early part of June. The worm folds the leaf by drawing the edges together, so that the upper surface is within the fold, and the whole thus forms a hollow case without an opening (Pl. II, Fig. 3, *b*). In this it lives protected, feeding only upon the parenchyma. The worms (Pl. II, Fig. 3, *a*) are found throughout the summer and autumn, there being, according to Mr. Chapin's observations, but one annual brood. Upon the approach of winter the worm lines the folded leaf inside with silk, and falls with it to the ground, where it remains in the larval state until the following April or May, when the transformations take place as already described. Just prior to the emergence of the moth, the chrysalis partly works its way through the back of the leaf, to facilitate the exit of the perfect insect.

In a paper read before the Western New York Horticultural Society, in the fall of 1877, Professor Comstock urges the very simple and obvious preventive for the injuries of this insect of raking together all the leaves in an infested orchard, soon after they fall in the autumn, and burning them, thus destroying the inclosed worms. When these are actually feeding on the tree their injuries may be arrested in a nursery or young non-bearing orchards, by syringing upon them water in which either Paris Green or London Purple has been stirred at the rate of 1 pound to the barrel.

The colors of the moth (Pl. II, Fig. 3, *c*) are white, with brown moltings and shades. It was briefly described by Clemens, in 1860,* under the name of *Anchylopera nubeculana*, and subsequently more fully characterized under the genus *Phoxopteris*, by Zeller†, who gives a figure of the right upper wing, which differs somewhat from the more common form as bred by me.

DESCRIPTIVE.

PHOXOPTERIS NUBECULANA.—*Larva*—Length when full grown 11.5^{mm}. Color greenish yellow. Head horizontal, rather narrow, gamboge yellow, with dark trophi. Cervical shield somewhat paler, occupying nearly the whole dorsal portion of prothoracic joint, and having a conspicuous black spot near each outer hind corner. Anal shield of same color, with two less conspicuous spots, which may coalesce and form a crescent. Piliferous spots rather large, paler than body, well relieved and normally placed.

Chrysalis—Length 9^{mm}. Color yellowish brown. Wing sheaths reaching to 4th abdominal joint; antennal sheaths not quite so far. Anterior and posterior borders of each abdominal joint armed dorsally with a transverse row of minute, decurved spines. Anal joint quite sharp.

* Proc. Acad. Nat. Sci., 1860.

† Beitr. z, Kennt. N. A. Nachfalter, p. 249.

THE THICK-THIGHED WALKING-STICK.

(*Diapheromera femorata*, Say.)

[Ord. ORTHOPTERA; Fam. PHASMIDÆ.]

Plate III, Fig. 1.

Certain elongate insects belonging to the *Orthoptera*, and popularly known as "Walking-stick" or "Walking-leaves," according as they lack or possess wings, have long been recognized as among the most *bizarre* of entomological creatures. Mimicking to a remarkable degree, as their popular names imply, the twigs and leaves upon which they dwell, these insects find their most congenial home in the tropics, where some of the species attain to over a foot in length, exclusive of the legs. The most common and wide-spread species in North America is the subject of the present sketch.

NOMENCLATURE.

Owing to its curious, slender, long-legged, slow-moving characteristics, it has been properly dubbed the "Walking-stick," "Stick-bug," "Specter"; while in some localities it is known as "Prairie Alligator," "Devil's Horse," and other odd cognomens, generally indicative of its appearance and of a superstition which is quite prevalent, but most unfounded, that it is poisonous, and can sting or bite.

The species was described by Say, in 1824* as *Spectrum femoratum*, while the genus *Diapheromera*, to which it is now referred, was characterized by G. R. Gray in 1835.†

The popular name above employed will serve to distinguish it from another tolerably common species, the Two-striped Walking-stick. (*Anisomorpha buprestoides*, Stoll.)

CHARACTERS.

The colors of the adult are quite variable, and are generally obliterated in cabinet specimens. Shades of gray, brown, and greenish-brown predominate, the head of the male being paler and having three longitudinal fuscous stripes, and the middle thighs having annulate shades of the same color. The front legs of the male and the shanks of the others are almost always green. The colors of the female are more uniform, generally grayish, with paler specks and mottlings on the head and along the back; but occasionally pale green predominates. Structurally the male is at once distinguished by his shorter, more slender body; his longer legs and feelers; his narrower and less dilated front thighs; his swollen middle thighs, and by the greater stoutness of the spines near the ends of the middle and hind thighs, these and the other distinguishing sexual characters being less obvious in the earlier stages of growth.

DESTRUCTIVE POWERS.

This insect has always been considered harmless, or, as Harris puts it, has "not proved so injurious as particularly to attract attention."‡ In

* App. Long's Second Exped., p. 294.

† *Diapheromerus Sayii.* Synopsis of the Species of Insects belonging to the family of Phasmidæ. London.

‡ Ins. Inj. to Veg., p. 147.

1872, however, while lecturing at Cornell University, I noticed that it was unusually abundant around Ithaca, and it was there reported as doing considerable injury to the rose bushes and other shrubs. The following letters from correspondents will, also, show that Harris's verdict, which is that of all other standard authors, can no longer be considered correct:

Inclosed find specimens, male and female, of an insect which is proving to be a scourge. About the middle of June I discovered, mostly on standing grass, this same insect, only very much smaller, of a light pea-green color, but not in sufficient numbers to be thought of as a pest. I noticed about August 15, in the reservation of young timber, mostly white oak and hickory, a few trees having the appearance of being burned just enough to kill the leaves. On closer investigation I found many of these insects devouring the leaves. Later, I judge at least 25 acres were completely stripped of foliage; as much so as if fire had run through the wood and killed every tree. They seemed to have no choice as to what variety of timber they attacked. There were many in my peach orchard and lawn. On single trees, far removed from my timber lot, they were as thick as could well be, in many places in heaps. Fences adjoining the timber were fairly covered with them. They have been known for years in this vicinity, but were heretofore always considered harmless. From present appearances they are greatly to be feared as a scourge, consequently anything relating to them will be read with great interest. I hear from them in Florida, but not in such numbers as here.—[G. C. Snow, Yates County, New York, in New York Weekly *Tribune*, November 11, 1874.]

About forty years ago my father set out a grove of locust trees for fencing purposes, at the foot of a rocky, wooded hill. The trees throve, and for years have furnished the farm with posts and stakes. When they were young we began to notice on them, now and then, the insects known as "Walking-sticks," and some fifteen years ago they began to increase rapidly, appearing in summer on the locusts, to which at first they seemed to confine themselves, entirely stripping them of their leaves, and have done so every second year since.

The locusts have nearly all succumbed to the repeated attacks of these repulsive-looking pests, which have for some time extended their operations to the adjoining native trees, most kinds of which they feed upon ravenously.

I have never by observation been able to discover when or where the eggs are deposited, nor can I find more than a description of the insect in any book within my reach. Will you throw a little light on the subject, and can you suggest any method of destroying these pestiferous walking-sticks?—[R. E. R. Ferrisburgh, Vt., in *Rural New Yorker*, November 7, 1874.]

In June last we gave an account of a remarkable visitation of myriads of the insect known as the walking-stick (*Spectrum femoratum*) in Yates County, New York, and asked for information as to the appearance elsewhere. The following from Mr. E. H. Conklin, Cumberland County, Pennsylvania, is the first response, which we hope may call out others. Mr. C. says: "This insect, though not at all common, and seldom numerous, has made its annual appearance in our peach orchards for forty years, and only once in this time have they been so numerous as to be injurious. In this instance, which was about ten years ago, these insects denuded a row of locust trees that formed a shelter on the northwest side of a peach orchard. For half a dozen rods from this locust row the peach trees were also stripped of their leaves. Previous to this time we never saw them on any other trees except the peach. As to color some are light-green, and others brown, amongst male and female. The female has a much heavier body than the male.—[*American Agriculturist*, August, 1877.]

A further account of great injury to oak timber by this insect on Mr. Snow's farm was given in the *American Agriculturist* for June, 1877, and when applications were made through the editor of the said journal for more definite information and for some practical recommendations, so little was any one able to comply with such a request, I deemed the matter of sufficient interest and importance to warrant further investigation. A couple of visits to Esperange farm enabled me to clear up the insect's natural history, and suggested, as the sequel will show, a simple and feasible means of preventing its injuries.

Mr. Snow has about 50 acres of woodland, consisting of fine young trees, mostly the second growth of hickory, and of different species of oak. In 1874 the trees on about 25 acres were totally defoliated. In

1875 the insects appeared in fewer numbers. In 1876 they were even more numerous than in 1874, and covered a larger area. In 1877 again they attracted less attention, while last summer I found that Mr. Snow's accounts were by no means exaggerated. By the middle of August the bulk of the pests were going through their last molt, and by the end of autumn they had stripped most of the trees, showing, however, a decided preference for the Black, Red, and Rock-chestnut oaks over the White oaks and Hickories, which they affect but little till after the first-mentioned trees are stripped. The underbrush was also very effectually cleaned of its foliage, and the insects hung from and clung to the bare twigs and branches in great clusters. They settle to roost on the Witch hazel, but do not defoliate it until the other trees mentioned are pretty bare. Sumach and Thorn are also little affected, while Peach and Apple in an adjoining orchard were untouched. Whenever they have entirely stripped the trees and shrubs they move in bodies to fresh pastures, crowding upon one another and covering the ground, the fence-rails, and everything about them so that it is impossible for a person to enter the woods without being covered by them. The timber affected can be recognized by its seared and leafless appearance from a great distance, and upon entering the woods the ear is greeted by a peculiar seething noise, resulting from the motion of the innumerable jaws at work on the leaves. Their depredations first begin to attract attention soon after wheat harvest, and are most noticeable in September. The injury to the trees done in 1874 and 1876 was manifest in the death of most of the black oaks, and, according to Mr. Snow's observations, trees die in three years after the first attack.

The unexampled multiplication and destructiveness of this insect at Esperange farm is but one of the many illustrations of the fact long since patent to all close students of economic entomology, that species normally harmless may suddenly become very injurious.

NATURAL HISTORY.

Owing doubtless to its having so generally been considered harmless, the habits of the Thick-thighed walking-stick have not hitherto been carefully studied; and it was not known how it passed the winter or where the eggs were laid. These eggs, which were first briefly described by me in 1874,* are 2.8^{mm} long, oval in shape, slightly compressed at the sides, and of a polished black color, with a ventral whitish stripe. They look not unlike some plump, diminutive leguminose seed. They are simply dropped loosely upon the ground from whatever height the females may happen to be, and, during the latter part of autumn where the insects are common, one hears a constant pattering, not unlike drops of rain, that results from the abundant dropping of these eggs, which in places lay so thick among and under the dead leaves that they may be scraped up in great quantities.

From general observations of specimens kept in confinement, it would appear that each female is capable of laying upwards of a hundred. The eggs remain upon the ground all through the winter and hatch for the most part during the month of May. Some of them, however, continue hatching much later, so that all through the summer and even into the fall, young individuals may be found. The embryo just about to hatch lies within the egg with the head pressed against the oval lid, and the body curled around so that the end of the abdomen, which is thick-

*New York Weekly *Tribune*, November 11, 1874.

ened and contracted, reaches near the mouth. The long antennæ project in front of the head and follow the curve of the body and the long legs are folded up in the central space. At an earlier embryonic stage the abdomen is enormously enlarged and the members are correspondingly small. The young walking-sticks measure at birth 4.5^{mm}, and with their feelers and legs outstretched, nearly double that length. They are invariably, during early life, of a uniform pale yellowish-green color, and as they have a habit in their earlier days of keeping near the ground, this, coupled with a great readiness to drop whenever disturbed, serves to protect them from observation. They may for these reasons occur in great numbers in the early part of the season without being suspected. The insect changes very little in appearance from birth to maturity except so far as color is concerned, and molts but twice. Growth is rapid, averaging, under favorable circumstances, about six weeks from birth to maturity. With age the green color gives way to various shades of gray and brown. In this way we find great correspondence with its surroundings. While the vegetation is green, the specters are green also; when the foliage turns in autumn, they change color correspondingly, and when the foliage is stripped they so closely resemble, in both appearance and color, the twigs upon which they rest—the habit of stretching out the front legs and feelers greatly enhancing the resemblance—that when they are few in numbers it is difficult to recognize them. A few green specimens, more particularly of the males, may always be found, even among the mature individuals.

In contemplating these singular creatures and their wonderful resemblance to the oak vegetation upon which they occur, one cannot help noticing still further resemblances. They are born with the bursting of the buds in the spring; they drop their eggs as the trees drop their seeds, and they commence to fall and perish with the leaves, the later ones persisting, like the last leaves, till frost cuts them off.

ITS APPEARANCE EVERY ALTERNATE YEAR.

As will have been already noticed, Mr. Snow has found from his own observations that the insects were injuriously abundant every other year, and I have been interested in endeavoring to find an explanation of this fact. The increase of the insect's natural enemies whenever they become excessively abundant, and the consequent decrease of the plant feeder the following year, undoubtedly have something to do with it; but there is also good evidence that a great many of the eggs remain on the ground for two consecutive winters before hatching. Messrs. T. W. Bringham and L. Trouvelot have both found from experience that the eggs of this insect for the most part hatch only after the interval of two years,* and an examination made of a large number, which I have myself kept the present winter, shows that while some have proceeded far in embryonic development, others show no development whatever, thus corroborating the experience of these gentlemen.

We may very justly conclude, therefore, that the species will only be injurious every alternate year.

NATURAL ENEMIES.

Among the natural enemies of this Walking-stick, Mr. Snow has observed that the crows were very abundant about them, as well as some

* Proc. Bost. Soc. Nat. His., Vol. XI, pp. 88 and 89.

other smaller birds. Turkeys, as well as chickens, also feed upon them, and may be made good use of while the insects are young and remain near the surface of the ground.

Of the insects that prey upon them, I noticed, both in the immature and perfect states, three species of Half-wing bugs (*Heteroptera*), namely, *Arma spinosa*, *Podisus cynicus*, Say, both in the typical form, and in the variety *obscuripes* as determined by Professor Uhler; also *Acholla multispinosa*, De Geer.

REMEDIES.

While the insects are young, they may be destroyed by sprinkling the underbrush in the timber with Paris green water, wherever the timber is inclosed so that domestic animals can be kept away from the poisoned vegetation.

The most satisfactory means of averting the insects' injuries, however, will be found in the destruction of the eggs during winter. This may be done either by digging and turning them under, or by burning over the dead leaves among which they lay.

DESCRIPTIVE.

DIAPHEROMERA FEMORATA.—*Egg*—Bean-shaped, hard, and highly polished; obliquely truncate at anterior end, which consists of a dark, oval, raised rim, inclosing a slightly elevated, convex, densely and deeply punctate brown lid, which is replaced after the young has hatched by the white, sunken amnion, which is shed within the egg. Color black, with frequently a faint olivaceous hue, the ventral side in strong contrast, whitish, inclining to pale fulvous, and with an elliptical scar recalling the hilum of a seed, the interior slightly depressed, the borders slightly raised. This scar reaches to near the lid anteriorly and ends in a cord posteriorly, to which cord the black color of the posterior extends in a broad point. There is usually more or less black within the posterior portion of the scar. Average length 2.5^{mm}; depth 1.6^{mm}; thickness from side to side 1.2^{mm}.

Larva—When newly hatched 11.5^{mm} long, exclusive of antennæ. Color, uniform pale yellowish-green, the front pair of legs speckled with brown. Antennæ with rather prominent bristles. Sex undistinguishable. Femora sub-equal in size. No femoral spines.

THE GREAT ELM LEAF-BEETLE.

(*Monocesta coryli*, Say.)

[Ord. COLEOPTERA; Fam. CHRYSOMELIDÆ.]

The injuries of the imported elm leaf-beetle (*Galeruca xanthomelæna*, Schrank)—a small pale-yellow insect with black stripes, and having the general size and appearance of the well-known striped cucumber beetle) have been long recorded and are well known in the Southeastern States. Some interesting observations on this species have been made during the year on the department grounds, with the view the better to control it, but want of space and time will prevent publishing the results in this report.

I desire to call attention, however, to a much larger beetle, having very similar habits, and which has proved extremely destructive to the Red or Slippery Elm in Missouri during the past few years. The sudden appearance of this insect in such excessive numbers as to absolutely strip all the elms of this species through the woods for many miles must be looked upon as phenomenal; for while J. F. Melsheimer reported the beetle many years ago as sufficiently numerous in some parts of Virginia to completely defoliate in a short time the hazel (*Corylus Americanus*),* the species is generally considered a rarity in entomological cabinets. Nor can I find that anything has been recorded of its adolescent stages. The beetle was first described by Say (*loc. cit.*) as *Galeruca coryli*, and is the only North American species of the genus

**Auctore* Say, Journ. Ac. Nat. Sc., Phil., III, 1824.

Monocesta to which it is now referred, the genus being more fully represented in Central and South America. The color is pale clay-yellow, with two dark, bluish spots on each wing-cover. These spots are variable in size, and sometimes entirely wanting.

My attention was first called to the injuries of this larva some three years ago by Mr. Geo. W. Letterman, of Allentown, Mo., and I have since been able to trace the full natural history of the species as it is given below.

The parent beetles (Pl. IV, Fig. 1, *jj*) make their first appearance during the month of June, when they may usually be found pairing on the tree first mentioned. The eggs (Pl. IV, Fig. 1, *a*) are laid on the under side of the leaf in a compact, more or less globose, gamboge-yellow cluster, each egg surrounded and the whole mass firmly held together by a glutinous substance. There are, on an average, about 125 eggs in each mass, the eggs being laid in layers. In general appearance the mass bears a resemblance to a yellow raspberry. Each egg (Pl. IV, Fig. 1, *b*), when examined separately, is seen to be subspherical in form and highly polished.

The young larvæ (Pl. IV, Fig. 1, *c*) hatch in about a week after the eggs are laid, and at first congregate around the empty egg-shells, which they nibble and feed upon. For about two days they remain close to their birthplace, eating only the parenchyma of the leaf, and showing so little inclination to travel that, should the leaf by accident be detached, they perish rather than search for another. They have at this stage of growth the curious habit, when disturbed, of raising the abdomen to a nearly perpindicular position, holding on to the leaf very firmly with their jaws. They are at this time of a glossy yellow color, and generally shed the first skin two days after birth, the empty skin adhering tightly to the leaf.

In the second stage, the color of the worms becomes more brownish, and they are more active, but still remain clustered together upon a single leaf or branch, scattering but slightly in proportion as they skeletonize one leaf after another. They yet, for the most part, feed upon the under side of the leaf, not touching the upper skin, and giving to the leaves a brownish, speckled, and seared appearance, as if covered by patches of some brown fungus. The excrement is voided in long, bead-like strings, which cover the ground or hang down from the branches and leaves of the infested trees. In another week, or when the larvæ are about half grown, a second molt takes place, they preparing for it in the usual manner by firmly attaching the anal joints to the leaf. (Pl. IV, Fig. 1, *e*.) In the beginning of the third stage they feed indiscriminately on either side of the leaf, but still refuse to touch the epidermis of the opposite side. The gnawings on the upper side at this stage of growth are peculiar, being in the form of crescent lines with narrow strips of epidermis between them; whereas on the under side there is no such regularity, and all is eaten but the stronger cross veins. I have been unable to trace any further molts. This third stage lasts from two to three weeks, the larvæ scattering more thoroughly and the general color becoming quite brown or yellowish-brown. As the worms reach full growth (Pl. IV, Fig. 1, *ddd*) the fleshy part of the leaves is entirely eaten so that little remains but the principal ribs, and the leaves thus present a very ragged appearance.

Toward the end of July and early in August the worms cease feeding and descend into the ground, burrowing therein and forming a simple oval cavity a few inches below the surface. They lie dormant therein

through the fall, winter, and early spring months, assuming the pupa state (Pl. IV, Fig. 1, *i*) but about a week before the beetles issue.

Experiments made upon the larva of the imported elm leaf-beetle show that Paris green water is very effective in destroying it, in both the larva and beetle states; and, while I have had no opportunity of making such experiments with the species in question, I have no doubt that it would here prove equally destructive. The larvæ are, throughout their existence, quite sluggish and drop to the ground on slight disturbance. A good shaking of an infested tree, therefore, will bring most of them to the ground, and experience shows that they have little or no capacity for mounting the tree again. This remedy will be applicable to cultivated trees, especially before they get too large.

THE JUNIPER WEB-WORM.

(*Dapsilia rutilana*, Hübn.)

[Ord. LEPIDOPTERA; Fam. TORTRICIDÆ.]

Plate V, Fig. 1.

Among the insects to which I have given some attention during the year is one which may be known by the above popular name. Mr. P. H. Foster, of the Babylon nurseries, Babylon, L. I., had already corresponded with me about the ravages of this worm in 1877, and, after rearing the perfect moth and ascertaining the principal facts in its natural history, I had given no further attention to the matter until the following letter was received:

BABYLON, L. I., *May* 13, 1878.

DEAR SIR: I send you, by mail this day, some specimens of diseased Juniper. I find a very small worm encased in a covering, some of which, no doubt, can still be found in the specimen sent. Also one perfect insect and one pupa can be found. I have in my nursery from 200 to 300 fine Irish and Swedish Junipers, and unless I can find a remedy they will soon be worthless to me.

Yours, respectfully,

P. H. FOSTER.

The injuries of this insect had never before been reported in this country, but the species has long been known to affect Junipers in the south of England and other parts of Europe. The probability is, therefore, that it is a comparatively recent importation, though Mr. Foster can give me no information that satisfactorily bears upon the point, since he himself never imported any Junipers, but obtained his stock when quite small of Messrs. Higgins, of Flushing.

Heine* cites this species as having but a limited distribution, reaching in Germany to Mecklenburg. It is rare there, the moth appearing in June and July.

In England the moth is known to appear as late as July and August.

All the facts ascertained about the habits of the species would indicate that there is great irregularity in development, but there is but one annual brood. The insect hibernates at different stages of larval development, and the chrysalis is found throughout the spring months. The moths begin to appear as early as April, but continue to issue during the summer.

The eggs, which are not yet known, are doubtless laid singly upon different parts of the tree during the summer months and the worms

*Schmetterlinge Deutschlands und der Schweiz.

begin to appear in autumn. I found no trace of them in July, and Mr. Foster has often wondered what became of them during the summer.

The worm from birth webs the leaflets together (Pl. V, Fig. 1, *a*) and lives within a more or less perfect silken tube; this tube being more complete around the hibernating individuals. The sprigs and branches affected by the worm present a seared and brown appearance, and a tree badly affected, may be recognized at a great distance. The Irish and the Swedish Junipers (varieties of *J. communis*) are both badly affected, but I did not find it on the *Juniperus Virginianus*, which is indigenous to the island.

It is difficult to reach this worm by any application that will kill it by contact, and for that reason the only way of ridding the trees of it is to use some poison, like Paris green or London purple, that will be eaten when the worm issues from its web to feed.

In point of fact, Paris green water proved effectual in some experiments made with it at the department on living worms in confinement, whereas gasoline, which Mr. Foster applied to the trees, seemed to have little effect.

Another web-worm, *Ypsolophus marginellus*, feeds in a similar manner on Juniper in England, but is not found in this country.

DESCRIPTIVE.

DAPSILIA RUTILANA.—*Larva*—Normally constructed, carneous in color, the head and pro-thoracic shield highly polished, deep gamboge-yellow. The head retractile, oblique. Ocelli and mandibles more dusky. Body wrinkled, tapering very gradually from meso-thoracic joint to anus. Normal complement of legs. The piliferous spots extremely small and indicated more by the short, pale, glistening setous hairs arising therefrom. Wrinkles as in Fig.—. Hind borders of abdominal joints slightly thickened dorsally.

Chrysalis—Color honey-yellow, the skin so delicate that the colors of the imago show clearly through it prior to emergence. Normally shaped, elongate, slender; the abdominal joints having, superiorly, two transverse rows of rather minute spines; the anus blunt and unarmed; the venter with a few blunt, setous hairs; the antennial sheaths reaching not quite to the tip of the wing sheaths. Average length, 5^{mm}.

Imago—Average expanse, 12^{mm}. Primaries, bright, glossy orange, crossed by four reddish-brown bands. The second band from the costa is slightly angulate; the third band has the form of a letter K, the top of the K being usually closed, though occasionally open. The apical band is wedge-shaped, reaching nearly to inferior angle. Frequently this coalesces with the inferior part of the third band. Indeed, as Wilkinson states,* though constant in color and size, much variation is found in the ornamentation of the primaries. Secondaries dark gray, with cilia of same color.

THE CLOVER-ROOT BORER.

(*Hylesinus trifolii*, Müller.)

[Ord. COLEOPTERA; Fam. SCOLYTIDÆ.]

Pl. V, Figs. 2 and 3.

In September, 1878, I received from Mr. G. C. Snow, of Branchport, N. Y., roots of clover that had been ruined by a small beetle not before reported in this country as having this habit. The insect was found in all stages of growth, though the principal injury had evidently been done by the larvæ, which worked more particularly on the larger roots. These last, in many cases, were entirely severed at the surface of the ground. The flower-stalks were also in many cases eaten into. A visit subsequently made to Western New York revealed the fact that in Seneca, Ontario, and Yates Counties this new enemy to American agriculture had been prevalent enough to prevent the cutting of the clover, the roots being entirely devoured and the plants pulling out with the greatest ease and gathering in windrows before the mower. In the fields affected I failed to find, after hours of search, a single plant that did not contain the insect in some stage, and in fewer or greater numbers.

* British Tortrices, p. 318.

This beetle has for many years been known in Europe, and in Germany more particularly, where, as appears from recorded accounts of its manner of working, its habits are exactly as I have found them in this country. Mr. Pfarrer Schmitt, of Mainz, has given* what is perhaps the best account of this insect on record. Müller, who was the first to describe the species,† came to the conclusion that its natural food-plant was the *Trifolium pratense*, and that its work was the principal cause of the death of cultivated clover during the third year.

Mr. Schmitt, while accepting the first proposition, was inclined to doubt the truth of the second, and considered that the cause of the death of the plant the third year was due to the short duration of life of the plant and the mode of cultivation in Germany.

In that country clover is sown among wheat, and during the first year is cut with the latter. In the second year the clover is cut once for fodder, and a second time for seed. By this treatment, argues Schmitt, the clover plant is weakened, and suffers from exposure, rain, and frost, its roots begin to decay, and the plant usually does not survive a third summer. The nature of the soil may also have some influence.

Nördlinger ‡ states that the species is found in the roots of *Lartium scoparium*, while Kaltenbach § includes *Medicago sativa* among the plants whose roots it affects.

While the facts which I have been able to learn in relation to the insect's work in this country confirm the views of Müller rather than those of Schmitt, yet it is undoubtedly true that this beetle flourishes most in the roots of plants that have been injured and that have already begun to decay—bearing out in this respect the well-known habits of other species of its family which are known to prefer the bark of trees and the woody stems of plants that are sickly from one cause or another.

I have found the insect in all three stages of larva (Plate V, Fig. 2, *b*), pupa (*c*), and adult (*d*) up to the time of frost, though the perfect beetles at this season very greatly predominate. The insect hibernates in any of these three stages, and continues propagating as soon as spring opens, the beetles issuing from the ground and pairing during the early spring months. The female then instinctively bores into the crown of the root, eating a pretty large cavity, wherein she deposits from four to six pale, whitish, elliptical eggs. These hatch in about a week, and the young larvæ at first feed in the cavity made by the parent. After a few days, however, they begin to burrow downward, extending to the different branches of the root. The galleries made in burrowing run pretty regularly along the axis of the roots (Plate V, Fig. 2, *aaa*), and are filled with brown excrement. The pupa is formed in a smooth cavity, generally at the end of one of these burrows, and may be found in small numbers as early as September.

It is the custom in Western New York to sow the clover in spring on ground already sown to fall wheat. This is generally done while the snow is yet on the ground or while the frost is disappearing, one peck of seed being used to the acre. The clover is allowed to go to seed in the fall and usually produces but little. During the second year one crop of hay and a crop of seed are obtained. It is during this second year that the injury of the Hylesinus is most observed.

No experiments have yet been made with a view of preventing the

*Stettiner Ent. Zeit., 1844, pp. 389–397.

† Avis sur une espèce de Bostriche qui détruit les racines du Trèfle des près. Mém. Soc. Dép. Mt. Tonerre. I, p. 47 (1807).

‡ Die Kleinen Feinde der Landwirtschaft, 1869, p. 234.

§ Die Pflanzenfeinde, etc., p. 121.

injuries of this clover pest, and no other mode of prevention suggests itself to my mind than the plowing under of the clover in the spring of the second year, if the presence of the beetle is observed.

There exists another species of Hylesinus in this country so closely allied to *trifolii* that the two are easily confounded. The species in question was described by Dr. Le Conte as *opaculus* in 1868,* and has been found infesting Elm and Ash, by Mr. E. A. Schwarz. The Clover-root borer has been considered synonymous with *opaculus*,† but a critical examination shows the following pretty constant structural difference between the two:

DIFFERENCES

between

Hylesinus opaculus, Le Conte, and *H. trifolii*, Müller.

Hylesinus opaculus, Le Conte	*H. trifolii*, Müller
Stout, opaque; when mature of a uniform piceous-black color. (Pl. V, Fig. 3, *a*.)	Smaller, more slender, elytra somewhat shining; when mature piceous-black, elytra more or less reddish-brown. (Pl. V, Fig. 3, *e*.)
Head punctulate, not narrow in front, without transverse impression in front of eyes.	Head more strongly, rugosely punctured, with a transverse impression in front of eyes and narrowed in front.
Epistoma (Pl. V, Fig. 3, *b*) truncate or very slightly and broadly emarginate.	Epistoma (Pl. V, Fig. 3, *g*) tri-sinuate and consequently bidendate at middle; median sinuation sometimes [in the male?] triangular.
Labrum visible.	Labrum not visible.
Antennal club very large, oblong-oval, less solid; the two first joints shining and pubescent only at apex.	Antennal club much smaller, oval, solid, entirely opaque, and pubescent.
Thorax wider than long, very densely punctate; pubescence moderately thick and short.	Thorax as wide as long, more coarsely, rugosely punctate; pubescence very sparse but long.
Elytral striæ (Pl. V, Fig. 3, *d*) evidently impressed and regularly, coarsely punctate; interstices very distinct, each with a regular row of small tubercles, which become more acute toward the apex and the sides.	Elytral striæ (Pl. V, Fig. 3, *i*) hardly impressed and very coarsely punctate; interstices much less distinct, coarsely, rugosely punctate.
Pubescence very coarse and short.	Pubescence much finer, sparser, and longer.
Tibiæ (Pl. V, Fig. 3, *c*) hardly dentate.	Tibiæ (Pl. V, Fig. 3, *h*), with large teeth at outer apical edge.
Lives under dry bark of elm and ash trees.	Lives in the roots of clover.

That this insect also has its natural enemies, however insufficient they may be, is proved by the fact that I found preying on it a *Telephorid* larva, which agrees with that of *Telephorus bilineatus*, Say, as already described by me.‡

DESCRIPTIVE.

HYLESINUS TRIFOLII.—*Larva*—Of normal form and character. Length, 3mm. Head, honey-yellow, with the mouth parts brown; rest of body dingy white.

Pupa—Length, 2.2mm, characterized by having two minute spinous projections on top of head, and two somewhat larger anal points. The thorax has a slight medio-dorsal carina, and a few sparse bristles.

THE CLOVER-SEED MIDGE.

(*Cecidomyia leguminicola*, Lintner.)

[Ord. DIPTERA; Fam. CECIDOMYIDÆ.]

While the *Hylesinus* just treated of was proving so destructive to the roots of clover in Western New York, the seed itself, where the beetle was not working badly, was very seriously affected by the bright orange larvæ of a minute two-winged fly, having both the size and general appearance of the common Wheat midge (*Cecidomyia tritici*).

Clover infested with these larvæ was first sent to me the latter part of last August by Mr. Snow, and, upon subsequently visiting Western New York, I had an opportunity of studying the species in the field. It seems

* Trans. Am. Ent. Soc., 1868, p. 170.
† Proc. Am. Phil. Soc., 1876, p. 380.
‡ 4th Mo. Ent. Rep., 1871, p. 29.

to have attracted attention more particularly during the last two years,* and bids fair to become as serious a drawback to the raising of clover seed as the Wheat midge has in past years been to the raising of wheat.

The first published notice of this insect was in the different reports of the proceedings of the annual meeting of the New York State Agricultural Society, held at Albany in January, 1879, where Mr. J. A. Lintner, of the State Museum of Natural History, referred to its ravages, and briefly described the larva under the name of *Cecidomyia trifolii*.†

The larvæ (Pl. VI, Fig. 3, *a*) affect the heads of clover in the same well-known manner that the Wheat midge affects wheat, and in all essential life-habits agree, so far as I have been able to learn, with that species. When full grown these orange larvæ quit the clover heads, drop to the ground, and either work a short distance beneath the surface or hide under the dead leaves and other shelter that may be thereon. Here each forms an oval, compressed, rather tough cocoon of fine silk, with particles of the surrounding earth or other objects adhering to the outside and rendering its detection extremely difficult. The pupa state is assumed within the cocoon, and when about to give forth the fly the pupa works itself through its silken covering and to the surface of the ground.

The flies (Pl. VI, Figs. 1, 2) begin to issue in September, and continue issuing all through the mild autumn weather and during the ensuing spring. In a warm room I have had them issue all through the winter. None of the writers on injurious insects mention any midge of the kind as affecting clover in Europe, though Curtis‡ mentions what is evidently the larva of a Cecidomyia as affecting tares, the larvæ being concealed amongst the calyces and eating into and consuming the incipient pod. The flowers of the Bird's-foot clover (*Lotus corniculatus*) are also "strangely transformed" there by the larva of *Cecidomyia loti*.

If the injuries of this insect should become serious, the clover-seed raiser will be obliged to abandon for a series of years the growth of this crop, as in no other way are we likely to be able to affect the multiplication of the enemy. The more thoroughly farmers combine in this course in any given district the more effectual will be the eradication of the evil.

This clover midge is readily distinguished from the Hessian fly by being but half as large in all stages, and by the flies usually having fewer joints to the antennæ. From the wheat midge it is also readily distinguished in the perfect state, as this last has twenty-four joints to the antennæ in the male and twelve in the female.

DESCRIPTIVE.

CECIDOMYIA LEGUMINICOLA.—*Length, male,* 1.3mm *to* 1.6mm*; female,* 2.6mm *to* 3.6mm. *Alar expanse, male* 3 *to* 4mm*; female* 3.3 *to* 4.7mm. *Abdomen red, thorax brownish-red; antennæ pedicelled and* 15-*jointed in the male, sessile and* 16-*jointed in the female. Wings hairy; transverse veinlet feeble; palpi* 4-*jointed; ovipositor* 4-*jointed and as long as the body when extended.*

Egg—Unobserved, but will doubtless prove very similar to that of *tritici* or of *destructor*, that of this last being 0.5mm long, cylindrical, rounded at each end, soft, translucent, and pale orange-red in color.

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*From some facts which, as I learn from Mr. Lintner, have been communicated to him by Prof. H. Brewer, of Yale College, New Haven, Conn., it is quite probable that this same midge was at work on the clover in Tompkins County, New York, over thirty years ago.

†The description was repeated under the same name in the *Canadian Entomologist* (vol. xi, p. 45), but finding subsequently that the specific name had previously been applied by Loew (Verh. Zool.-Bot. Gesell. vol. xxiv, Wien, 1874) to a species forming a sort of gall on the common clover in Europe, Mr. Lintner recently substituted the specific name *leguminicola*. Meanwhile I had given it the name of *Lintnerii* in connection with the description here published, which has been in the printer's hands since last March. The delay in the publication of the report has enabled me to adopt Mr. Lintner's last name.

‡Farm insects, p. 487.

Larva (Pl. VI, Fig. 3)—Length 2.3^{mm}; diameter in middle of body about ⅓ of the length; ellipsoidal, sub-cylindric, flattened ventrally, tapering but slightly at the ends, which are rounded when at rest; surface minutely granulate. Joints well separated. Color, bright orange-red, inclining to pink when mature. Head small, brownish, sub-acute, and furnished with two prominent exarticulate antennal tubercles, which arise from lateral swellings and which are as long as the head proper is wide at base; basal piece or neck (erroneously considered an additional joint by some writers), into which the more horny part recedes, sub-quadrate. Abdominal joints sub-equal in length, except the last, which is very small, bilobed, and nearly surrounded by the penultimate joint. Stigmata raised on short tubercles which, from a ventral view (as in the figure), are seen projecting laterally from the anterior third of each of the first seven abdominal joints (jts. 4–10). The pro-thoracic and the eighth pair of abdominal spiracular tubercles are visible only upon a dorsal view, and are situated at the hind border of their respective joints, the former directed forward and the latter backward. The three thoracic joints and the two anal joints have each a strong lateral bristle. The "breast-bone" is honey-yellow, the stem narrow, the club with a circular notch in front and produced laterally, so as to have in all, four rather blunt points as in the figure.

Cocoon—Broadly ovoid, 2^{mm} long, opaque, tough, composed of very light gray silk, usually covered with dirt.

Pupal exuvium—Dirty white, with the antennal sheaths honey-yellow and projecting each side like the handles to an urn, the capitate bristles of moderate length, fine, and white.

Female—The denuded body of the female is bright red. Normally, however, each abdominal joint has a band of black, lanceolate scales, which obscure the color unless the body be stretched. Venter yellowish-gray, hairy. Legs brown outside, lighter inside. Head black. Antennæ yellowish-red; 16-jointed; joints sessile; the two basal joints globose, the rest sub-cylindrical, narrower anteriorly than posteriorly, convex in front, concave behind; hairs sparse, as long as the joint, and curving forwards; no definite number of whorls. Palpi about as long as face; 4-jointed; jt. 3 as long as 1 and 2 together; jt. 4 one-fourth longer; all armed with short, sparse hairs. Halteres reddish-yellow, clavate. Wings closely pubescent, the fringe extending from the second vein to the hind base; transverse vein indistinct, and often invisible in specimens mounted in balsam. Ovipositor 4-jointed, telescopic; last joint with a ventral terminal slit; basal joint twice as long as broad; second joint four times as long as first; third joint three times as long as first; fourth joint as long as basal joint.

Male—Antennæ 15-jointed; two basal joints globose, the rest pedicelled; the pedicels white and as long as the globular part, which is nearly black; [left antenna of one specimen with but 14 joints, owing to a coalescence of the 5th and 6th]; more hairy than in the female, but with no definite number of whorls. Genitalia broad, prominent, protruded by a slender pedicel; each clasper consisting of a swollen basal joint and a terminal hook, which is obliquely truncate at tip.

Many specimens examined.

These Cecidomyiæ are often quite difficult to rear to the perfect state, and it has been customary to name them from the larvæ when these produce, as they very frequently do, galls or other abnormities of the food-plant, by which the species is readily recognized and distinguished. There is some discrepancy between the above description of the larva and that given by Mr. Lintner, who describes the lateral fleshy tubercles as arising "*at about the middle of each segment*," and does not mention the stigmata. Yet I cannot doubt but that the insect under consideration is the same species examined and studied by my friend.

Compared with the two other most destructive species of the genus—*tritici* and *destructor*—*trifolii* shows the following differences. The former has, on an average, 24 joints in the male and from 12 to 13 in the female antenna. *Destructor* has sometimes as many as 20 in the male and 19 in the female, though authors give an average number of 17; while *trifolii* has 15 in the male and 16 in the female. The number of joints varies, so that upon this character alone, unless there is great difference, specific distinctions cannot safely be founded.

In both *tritici* and *destructor* the joints of the female antennæ are pedicelled, while in *trifolii* they are sessile. In *trifolii* the palpi are 4-jointed, as they are also (according to Curtis) in *tritici*, while in *destructor* they are 3-jointed. In *trifolii* the transverse vein is present though indistinct; in *tritici* it is distinct, and in *destructor* it is absent. In *trifolii* the ovipositor is 4-jointed; in *tritici* and *destructor* it is described as 2-jointed; but here again the descriptions are at fault, due no doubt to the fact that the basal joint has been considered the terminal abdominal and that the separation of the 3d and 4th is readily overlooked. The male genitalia are larger and more prominent in *trifolii* than in either of the others. The larvæ of *trifolii* and *tritici* are very similar. The anal joint of *tritici* is, however, armed with six strong, pointed tubercles, which are not present in *trifolii*, while the antennal tubercles are longer. The spiracular tubercles are similar, but in *tritici* they are more dorsal and cannot be seen from a ventral view, while the last pair [on joint 11] is more prominent. The angles of the "breast-bone" in *tritici* are somewhat more rounded than in *trifolii*.

The larva of *destructor* differs radically from either of the others. It is about twice as large, and joints 10, 11, and 12 are crowded so closely together that it is difficult to distinguish them. The anal joint bears two rounded tubercles at tip. The spiracular tubercles are not perceptible; the head is more rounded than in *trifolii*; the antennal projections are much shorter. The "breast-bone" is smaller, the club being but little larger than the stem, which is slightly enlarged at base. The lateral angles to the club are entirely wanting.

THE APPLE COLEOPHORA.

(*Coleophora malivorella*, N. sp.)

[Ord. LEPIDOPTERA; Fam. TINEIDÆ.]

(Plate VII, Fig. 1.)

In the early part of June, 1877, I received a letter from Mr. William Fairweather, of Densmore Apple Farm, McLane, Erie County, Pennsylvania, in which he complained bitterly of the ravages of a certain case-bearing worm, specimens of which accompanied the letter.

Its method of work and the amount of injury done by the insect may be gathered by extracts from this and subsequent letters from Mr. Fairweather:

June 12, 1877.—I noticed it as soon as the buds began to swell, and it seemed as if there was one of each bud on almost every tree in the orchard. They are now attacking the fruit, eating a hole into the young apple formation and devouring the interior, leaving it a perfect shell. * * * Since writing the above I have examined some of the trees and found a great many of the limbs denuded of leaves, especially in the smaller trees, and a large number of the top shoots of the larger ones have never budded out, the buds having apparently been stung by the insect, and are now hollow and decayed.

June 22, 1877.—In addition to my former communication I have to say that the larvæ have now left the leaves, apparently satisfied with the amount of damage they have done, and taken up a *fixed* abode on the twigs. In our orchard of over 8,000 trees there is scarcely one which is not more or less infested. The small and weakly trees seem to suffer most, some of them having their leaves like perfect skeletons. * * *

July 7, 1877.—I find on examining the trees that the case-bearers have left their cases. They ceased working in the leaves about the time I sent you the last lot (June 22) and must now be flying about in the moth state. I noticed them first about the 1st of April, when the buds were commencing to shoot forth, and it seemed to me as if the eggs were laid right on the end of the bud, and as soon as it burst open the caterpillar was ready to commence active operations. * * * I noticed that the black ant, which is a vigorous foe to a good many species of caterpillar which attack the apple tree, is powerless against this pest, on account of the tough case or shield under which it carries on its destructive operations.

May 8, 1878.—It is worse this year than last, and has rendered large numbers of trees nearly leafless. The eggs are apparently laid on the end of the young bud before it opens, the leaves being thus attacked before they have a chance to grow. * * * It seems proof against insect enemies with its horny cover.

July 3, 1878.—At this season they get mostly out of sight. They have mostly finished eating the leaves now.

From the facts thus communicated; from observations made upon specimens sent by Mr. Fairweather, and from the known and quite constant habits of the genus to which the species belongs, we are able to give a pretty full account of this fresh addition to the already long catalogue of insects injurious to the Apple.

The moth (Pl. VII, Fig. 1, *d*), which, with the other members of the family, is a night-flier, issues from the chrysalis from the first to the middle of July. Judging from the well-known habits of the closely allied European *anatipennella* the female doubtless lays her eggs upon the under surface of the leaf, and the young larvæ hatch out in September, and live upon the under surface of the leaves until frost. They form pistol-shaped cases, which are very tough—almost horny in consistence—being made of silk, mixed with a small amount of excrement and with *debris* of leaves. The inside lining is, however, of pure, whitish silk. The posterior end of the case is curved as in the figure, and in the outer edge of this posterior curve is a longitudinal slit or orifice which the elasticity of the substance and the peculiar curve of the case

at that point tend always to keep closed. Considerable force from an *outside* enemy would be necessary to open this orifice, though from the inside the slightest pressure enables the larva to protrude its anal segment when the excrement is to be voided. It is through this opening, also, that the perfect moth emerges from the case.

During the autumnal months Mr. Fairweather seems not to have noticed the young larvæ, and they are then very easily overlooked for three reasons: 1st, their small size at this time; 2d, the size and toughness of the leaves; and 3d, the habit which the worms have of feeding in the fall on the under side of the leaf only. Upon the approach of winter they migrate to the twigs and fasten their cases thereto with silk, remaining fixed until early spring, when they begin operations by attacking the unopened buds. The injury which they do from this time on is shown in Mr. Fairweather's letters. The larvæ now feed upon and skeletonize the upper surface of the leaf, devouring only the parenchyma, and they also have the injurious habit, according to Mr. Fairweather, of burrowing into the young apples. About the middle of June they abandon the leaves, and, attaching themselves firmly to the twigs with silk, transform into chrysalides. Before doing this, however, they completely reverse their position in the cases so that the chrysalis faces the slit-like orifice where was formerly the anus of the larva. It seems as though the remark of Stainton,* to the effect that the chrysalis is inclosed in the last larval skin and is consequently never seen, is not carried out in this species, as the skin of the larva is completely cast off and wedged into the lower orifice of the case. In about three weeks the perfect insect issues, forcing its way through the posterior slit with the greatest ease, and leaving behind no trace of its exit.

The only enemy of this insect, so far known, is a minute Chalcid fly, which has increased to such an extent since the ravages of the Coleophora became apparent on Mr. Fairweather's place that it bids fair to render additional remedies unnecessary. The specimens sent in 1877 were not parasitized. Those sent in 1878 were about half of them affected, and of twenty-four specimens received in March, 1879, seventeen had been destroyed by this little fly, which I have not yet found time to properly study.

The same direct remedy recommended for Chapin's Apple-leaf roller and the Juniper Web-worm will apply here.

DESCRIPTIVE.

COLEOPHORA MALIVORELLA, N. Sp.—*Egg*—Unknown.

Larva—Length 4mm. Color pale yellowish, often with faint roseate hue. Head retractile, large, black, granulated, and with a few rather long hairs at sides; median suture white; antennæ 4-jointed, yellow, with the base of each joint white, the two basal joints equal in length, the third and fourth each one-half as long and more slender; a long bristle arises from apex of second joint. Prolegs brown with the tips whitish; thoracic legs yellowish with the claws blackish. Thoracic joints each with a blackish, strongly granulate chitinous patch at the lateral projection, the mesothoracic joint having also two narrow black transverse dorsal spots posteriorly, and a subdorsal yellowish spot of a similar nature. The two anal joints are covered with brown granulations and furnished with rather long hairs.

Imago—Female: expanse 14mm. Head, face, and palpi white. Antennæ white, annulated with fuscous; basal joint with a long tuft of intermingled white and fuscous scales reaching to sixth joint. Primaries fuscous (mouse color more nearly), with many white scales at base, especially behind the median vein. Cilia fuscous; secondaries fuscous; thorax white, with a few fuscous scales. Abdomen, with the anal tuft, whitish. Legs white with a ring of fuscous at the base of each tarsal joint. Male: expanse 12.5mm. Differs from female in the head, face, and palpi being fuliginous, and in having no tuft on the basal antennal joint; also, in being somewhat darker, the wings usually lacking the white basal scales, and the legs being more grayish.†

*Nat. Hist. of the Tineina, Vol. IV, p. 4.

† This species, in the sexual difference, conflicts with Stainton's grouping, in which species having a tuft to basal joint of antennæ and with the wings unicolorous are brought together.

FULLER'S ROSE BEETLE.

(*Aramigus Fulleri*, Horn.)

[Ord. COLEOPTERA; Fam. OTIORHYNCHIDÆ.]

Within the past five or six years frequent complaints have been made of the failure of Tea-roses, the cultivation of which has become a very important and lucrative branch of flower culture. This failure has recently been ascertained to be due to the larva of a little gray snout-beetle, shown in its different stages on Plate VII, Fig. 2.

Mr. Peter Henderson, of Jersey City Heights, N. J., has himself suffered very much from the work of this insect, and I have had considerable correspondence with him during the winter upon the subject. The following quotation is from one of my letters replying to his inquiries:

"The first knowledge which I obtained of this insect was through our mutual friend, Mr. A. S. Fuller, who sent me specimens in 1875, the species being then undescribed. In 1876 it was described under the name of Aramigus Fulleri, by Dr. G. H. Horn, in the proceedings of the American Philosophical Society, vol. xv, page 94. Mr. Fuller had found it in greenhouses, and somewhat injurious to camellias. It seems to be quite wide-spread, occurring from the Atlantic at least as far west as Montana, and its habit of injuriously affecting roses and other green-house plants must be looked upon as a comparatively recent acquirement. Such instances of newly formed habits are constantly presenting themselves to me in my studies of insects. The beetle seems to be purely American, and the genus Aramigus was in fact erected for it and another species (*Aramigus tesselatus*), of about the same size but of a silvery white color, with faint green hue, which I have found in Kansas upon the well-known "resin weed." The beetle belongs to the same family, and is pretty closely allied to a well known European beetle (*Otiorhynchus sulcatus*, Fabr.), which is larger and darker in color, and is also very injurious to greenhouse plants, as well as to some grown out of doors. This species also occurs in this country, as I have specimens that were taken in Massachusetts. It is the habit of all these beetles, so far as their habits are known, to work in the roots of plants while in the larva state, just as your Aramigus does. The eggs are doubtless laid upon the roots by the female beetle, which burrows into the ground for this purpose. Upon inquiry I found that what is evidently this same beetle has been more or less injurious to roses in and about Washington, and that Mr. A. Jardin was obliged to give up the growth of tea-roses here a number of years ago on account of its injuries."

Mr. Henderson himself gives the following account of the working of this insect in a recent number of the *Gardener's Monthly*:

*In the plain, practical, and excellent essay of Mr. Bennett on "Rose Growing in Winter," among the "Causes of Failure" which he gives, he fails to make any mention of the rose-bug, probably for the reason that he has so far in his operations been exempt from it, or has overlooked it.

It is a well known fact that probably not one gardener out of ten, whether florist or private gardener, who attempts to cultivate roses for their flower-beds during the winter months have complete success, and I am led to believe, from a pretty thorough investigation of the subject, by a correspondenee with some of the best growers in six different States, and from what personal observations I have been able to make in a number of places where roses are grown, in the vicinity of New York, that in a large majority of cases failure is traceable alone to the ravages of this insect. Its operations are so insidious that it may be sapping the life-blood from your plants year after year, and if you are ignorant of its existence, you can hardly be blamed for not knowing what is doing the mischief. * * *

Mr. John May, the gardener in charge of Mr. Slaughter's rose-growing establishment at Madison, N. J. which is probably the largest in the vicinity of New York, has given great attention to the rose-bug, his roses for four or five years being much injured by it, but by persistent efforts in destroying the perfect insect has now got entirely clear of it, so that his roses are now perfect models of health and vigor. He says that he is "convinced that no substance will destroy the insect in the larva state without at the same time injuring the plant." This has been the experience of all that we have heard of who have tried any such remedies, and the only advice that is given when there are indications that the plant is affected at the roots is to dig it up at once, or if grown in a pot throw it out, for you may just as well hope for health in a patient in the last stages of pulmonary consumption as to expect health from a plant with the rose-grub feeding on its roots. The symptoms of the grub being at the roots are a partial stagnation of growth, weak pale shoots, and generally barren of flower-buds. If these symptoms show in anything like a marked degree, if the plant is dug up and shaken, the insects in less or more numbers are almost certain to be found. The remedy is to carefully search for and destroy the perfect insect that is to be found under the leaves; these are by no means so numerous as the grubs, evidently showing that many of these in the larvæ stage die, or at least do not come to the surface. Complete destruction of the mature insect, which is easily accomplished by careful and persistent searching, is a certain remedy for the evil. * * *

An extensive florist from the interior of New York State sent me samples, the other day, of a grub that had been eating the roots of his geraniums, hibiscus, and dracænas, which, on examination, proved to be identical with the rose-bug maggot.

A study of the habits of this insect which I have been able to make through the courtesy of Mr. Henderson, who has sent abundant material to the department, enables me to add to his excellent account some facts that are both interesting and of practical value. The most serious injury is done by the larvæ, which feed principally upon the more tender rootlets and thus attack the plant in its most essential parts.

I have had a quite healthy rose bush totally destroyed in three weeks' time by about three dozen of the larvæ which were placed in the pot containing it.

The parent beetles (Pl. VII, Fig. 2, *c*, *d*), like most other snout-beetles, live for a considerable time, as I have kept them in confinement for nearly three months. They are nocturnal in habit, being quite active and feeding only after dusk. They shun the light during day-time and hide under the leaves or cling tightly to the branches or in some fork near the base of the plant, always in such position as not easily to be observed. They drop to the ground, draw up their legs, and "play 'possum," remaining motionless for some time and looking very much like a small lump of dry earth, the color adding greatly to the resemblance. This habit of simulating death upon disturbance is common to many other insects of this family. They feed upon the leaves, but do more injury by severing them than by the amount of foliage consumed.

The eggs (Pl. VII, Fig. 2, *e*) are laid in flattened batches consisting of several contiguous rows and each batch containing from 10 to 60. The individual egg is smooth, yellow, ovoid, and about 1^{mm}. in length. The female shows a confirmed habit of secreting her eggs, which are thrust between the loose bark and the stem, especially at the base just above the ground. In the twenty-odd batches which I have examined they have invariably been thrust either between the loose bark as above described, or into any other crevice that could be found; as, for instance, that formed by some loose paper around the edge of the bell-glass in which some of my experiments were made. More rarely they are laid between the earth and the main stem just at the surface of the ground. The eggs are so firmly glued together and to the place of deposit that they are not easily seen, and are with extreme difficulty detached.

These eggs require about a month to hatch, and the new-born larva, which is of a pale yellowish color, with light brown mouth-parts, is quite active, and immediately burrows into the ground, and acquires very soon after a bluish hue. Just how long this larva (Pl. VII, Fig. 2, *d*) requires

EXPLANATION TO PLATES

TO REPORT OF ENTOMOLOGIST.

When figures are enlarged, the natural sizes are indicated in hair-line at side, unless already indicated in some other way on the plate.

EXPLANATION TO PLATE I.

FIG. 1.—FULL-GROWN LARVA OF MULBERRY SILK-WORM.

FIG. 2.—COCOON OF SAME.

FIG. 3.—MALE MOTH OF SAME.

FIG. 4.—PIEDMONTESE SILK-REEL.

FIG. 5.—PLANE VIEW OF AN OLD FRENCH REEL.

EXPLANATION TO PLATE II.

FIG. 1.—SECTIONAL VIEW OF AN OLD FRENCH REEL.

FIG. 2.—IMPROVED LOMBARDY HAND-REEL.

FIG. 3.—PHOXOPTERIS NUBECULANA: *a*, larva, dorsal view, enlarged; *b*, leaf sewed together and with empty chrysalis shell extended from the under side, natural size; *c*, perfect moth, enlarged.

FIG. 4.—OUTLINES SHOWING SHAPES AND SIZES OF COCOONS OF DIFFERENT RACES OF SILKWORMS.

EXPLANATION TO PLATE III.

FIG. 1.—DIAPHEROMERA FEMORATA: *a*, egg, ventral view; *b*, same, side view, enlarged; *c*, eggs, natural size, with young just hatching; *d*, *d*, mature males, back and side views; *e*, mature female.

EXPLANATION TO PLATE IV.

FIG. 1.—MONOCESTA CORYLI: *a*, egg-mass; *b*, single egg; *c*, young larvæ, and manner in which they skeletonize the leaf; *d*, *d*, *d*, mature larvæ in different positions; *e*, larva molting; *f*, dorsal outline of one of the middle larval joints; *g*, head of larva from above; *h*, palpi of same from beneath; *i*, pupa; *j*, *j*, beetle, side and back view; *b*, *f*, *g*, *h*, enlarged, the rest natural size.

EXPLANATION TO PLATE V.

FIG. 1.—DAPSILIA RUTILANA: *a*, sprig of juniper, showing manner in which the larva works; *b*, larva, dorsal view; *c*, chrysalis, dorsal view; *d*, moth with wings expanded; *b*, *c*, *d*, enlarged.

FIG. 2.—HYLESINUS TRIFOLII: *a*, *a*, *a*, burrows made by the insect; *b*, larva, lateral view; *c*, pupa, ventral view; *d*, beetle, dorsal view; *b*, *c*, *d*, enlarged.

FIG. 3.—*a*, HYLESINUS OPACULUS, showing sculpture: *b*, epistoma; *c*, front tibia; *d*, elytral sculpture; *e*, *f*, *h*, *i*, same parts of *H. trifolii*; *g*, form of epistoma common in male; all enlarged.

EXPLANATION TO PLATE VI.

FIG. 1.—CECIDOMYIA LEGUMINICOLA, *a*, enlarged dorsal view of male with scales denuded; *b*, head; *c*, genitalia; *d*, antennal joints, more highly magnified to show structure; *e*, tarsal claw; *f*, *f*, forms of scales.

FIG. 2.—CECIDOMYIA LEGUMINICOLA: *a*, enlarged side view of female with scales denuded, to show more clearly the structure; *b*, head, more highly magnified, to show structure of the eye, palpi, and basal joints of antennæ; *c*, tip of ovipositor highly magnified, and showing at end of penultimate joint the manner in which it is clothed with minute hair; *d*, highly magnified antennal joints, their minute hairy clothing shown on the lower one.

FIG. 3.—CECIDOMYIA LEGUMINICOLA: *a*, larva enlarged, ventral view; *b*, head retracted and more highly magnified.

EXPLANATION TO PLATE VII.

FIG. 1.—COLEOPHORA MALIVORELLA: *a*, *a*, *a*, cases of different sizes, with leaves as they appear when fed upon, natural size; *b*, larva; *c*, pupa; *d*, female moth enlarged.

FIG. 2.—ARAMAGUS FULLERI: *a*, larva; *b*, pupa; *c*, beetle, outline side view; *d*, same, dorsal view, the outline between them showing natural size; *e*, eggs enlarged and natural size; *f*, left maxilla with palpus; *g*, under side of head of larva; *h*, upper side of same enlarged.

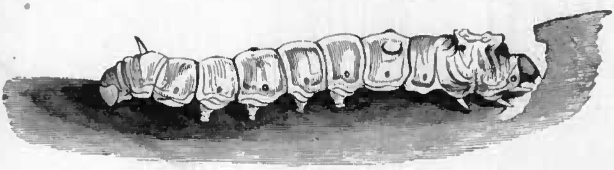


FIG. 1.

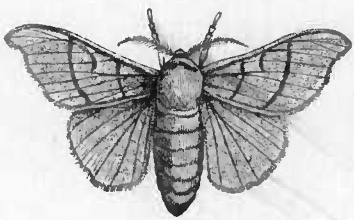


FIG. 3.

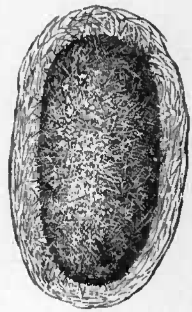


FIG. 2.

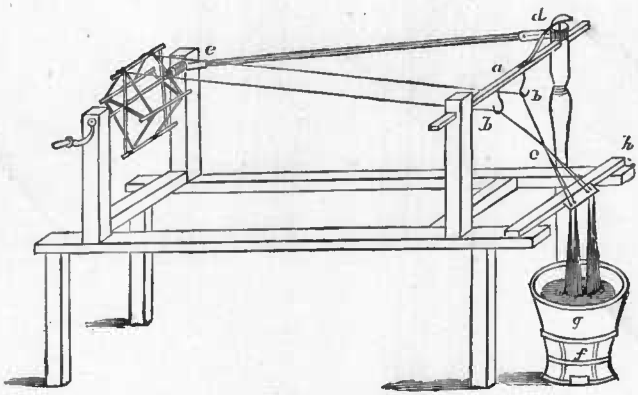


FIG. 4.

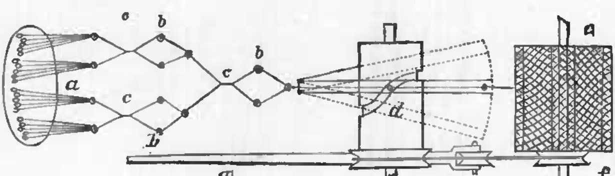


FIG. 5.

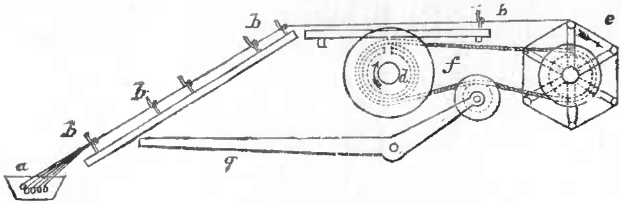


FIG. 1.

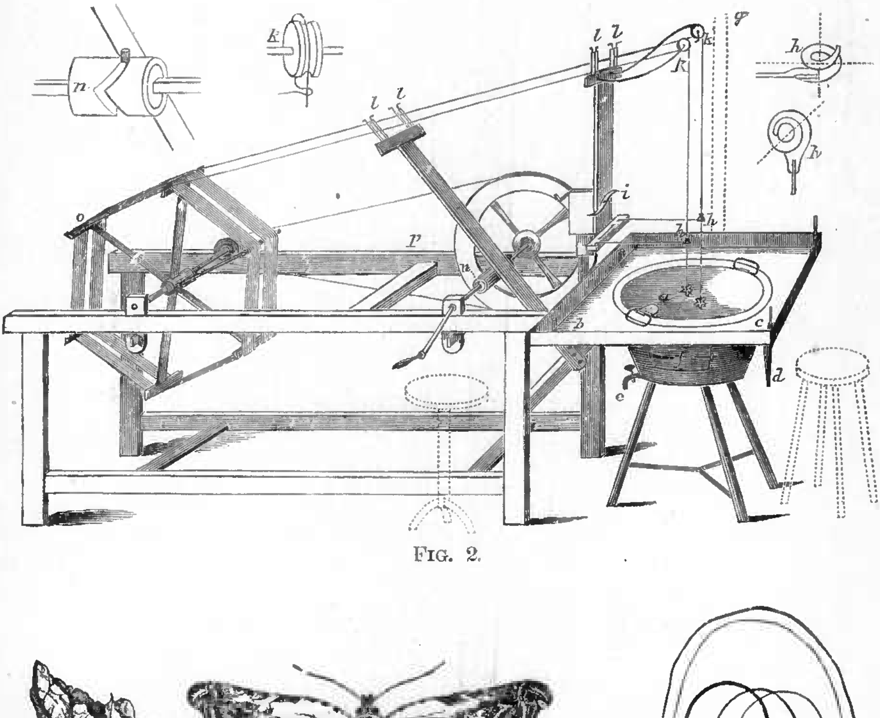


FIG. 2.

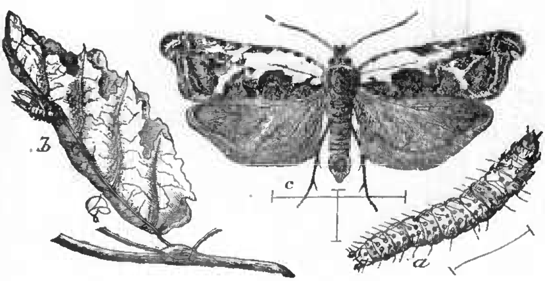


FIG. 3.

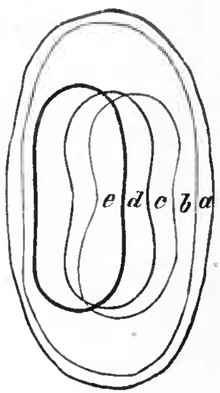


FIG. 4.

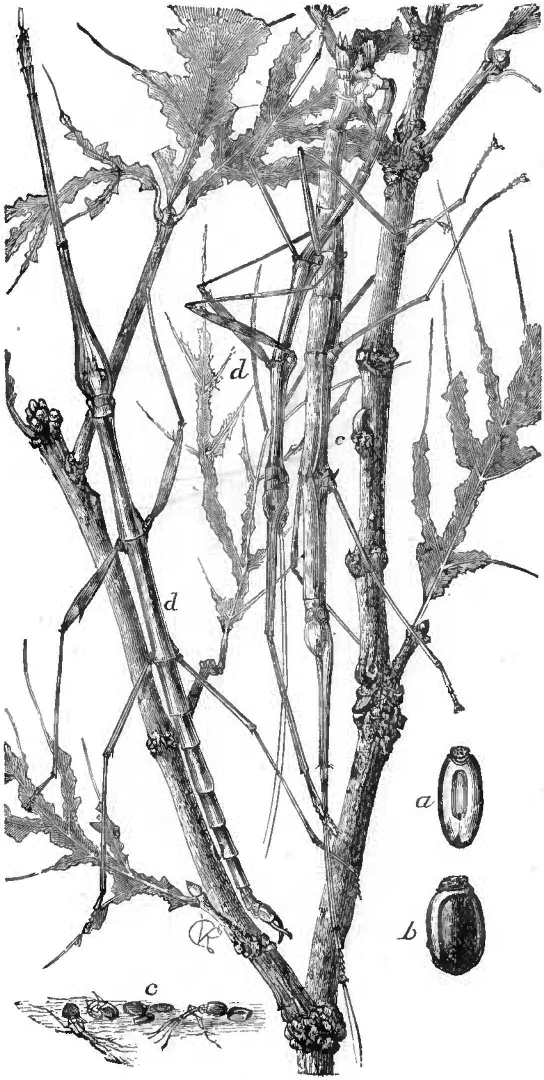
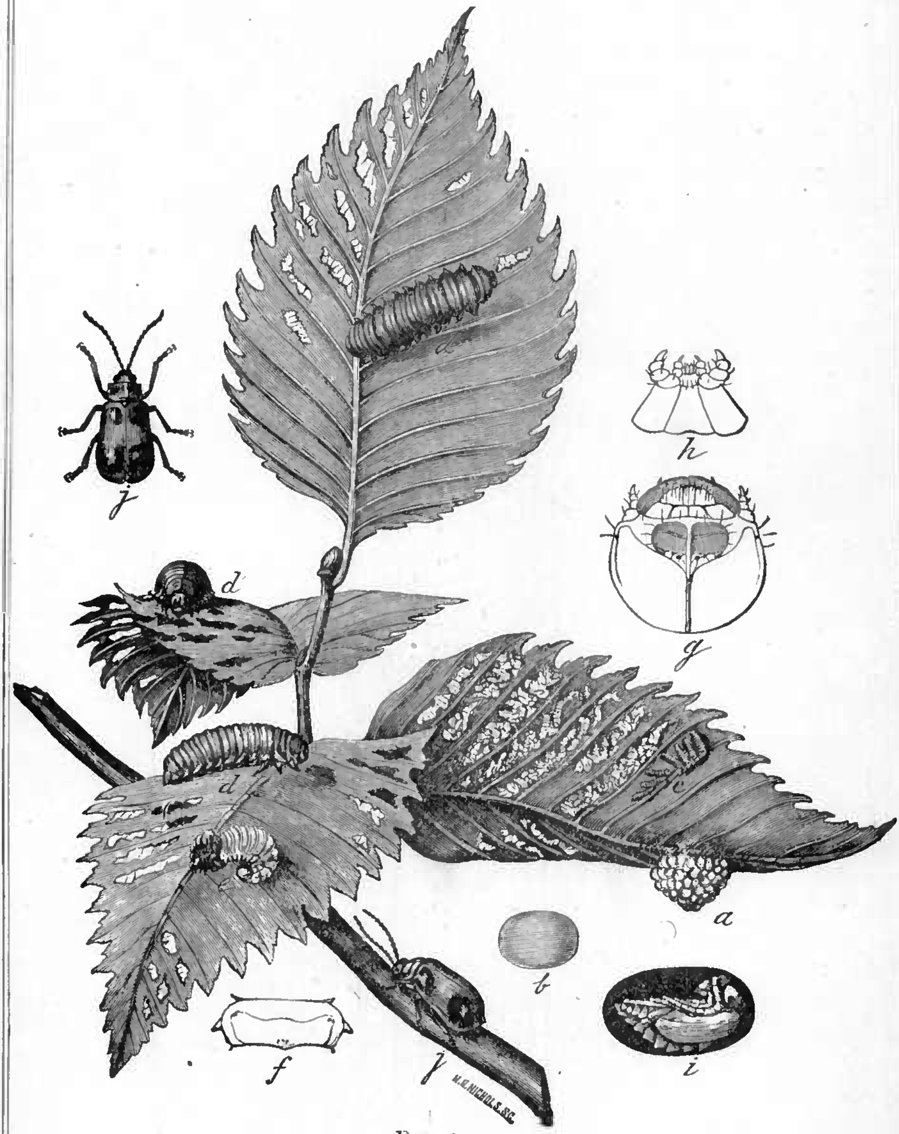


FIG. 1.



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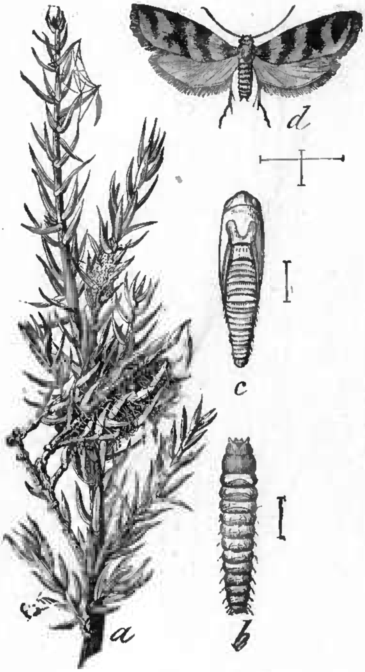


FIG. 1.

FIG. 2.

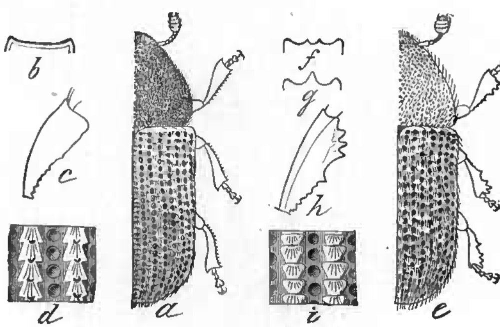


FIG. 3.

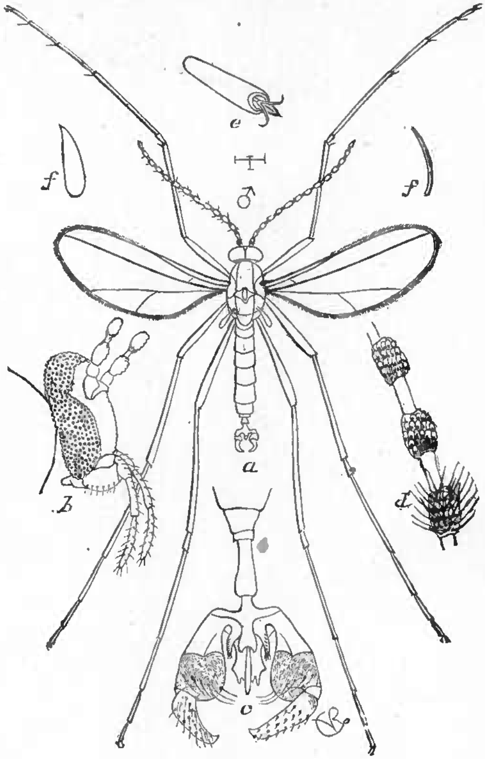


FIG. 1.

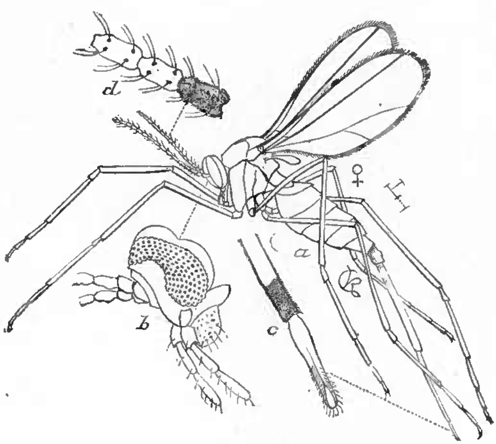


FIG. 2.

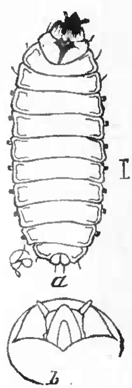


FIG. 3.

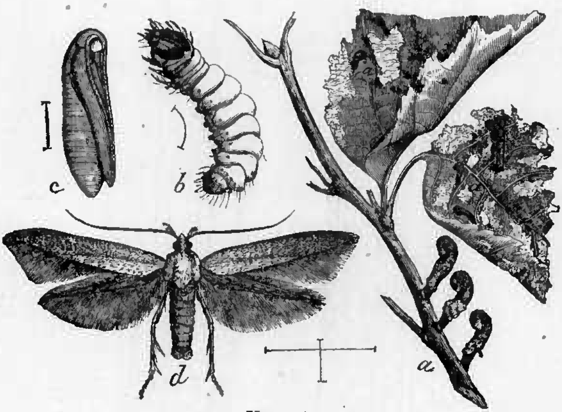


FIG. 1.

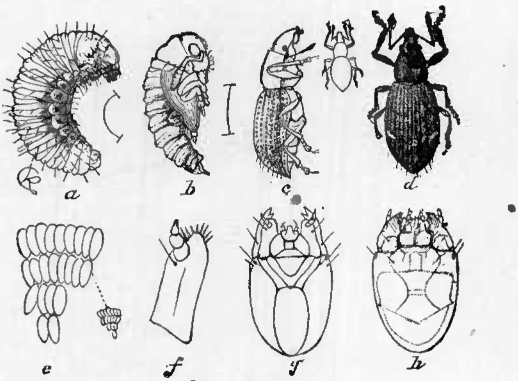


FIG. 2.

to attain full growth I have not been able to ascertain, but, in all probability, it remains at least one month, and probably several more, in the ground, where the pupa state (Pl. VII, Fig. 2, *b*) is finally assumed.

As the injury of this insect has been done mostly to roses under glass, there will be found no great regularity in its periods of transformation under such circumstances. In point of fact it is found in all stages during the winter and early spring months.

In addition to the recommendation of Mr. Henderson to destroy the perfect beetles, I would recommend, therefore, as an effectual preventive measure the tying of a few thicknesses of tape or of narrow pieces of rag, or even of stiff paper, around the butt of the plant to be examined, detached every three weeks, and burned if eggs are found in them. Where the number of plants is large, this destruction of the eggs might be expedited by the employment of traps consisting of small stakes around which such layers of cloth or paper are tied. These should be thrust in the ground near the main stem of the plant and can be collected once every three weeks, thrown into a tub of hot water, subsequently dried, and used again without untying the bandages. A few folds of oil-paper thrust into a slit in an ordinary wooden label—materials always at hand in a green house—might also be advantageously employed.

DESCRIPTIVE.

ARAMIGUS FULLERI.—*Egg*—0.9mm long and about one-fourth as wide; smooth, soft, and pale translucent yellow; normal form ellipsoidal, but varying greatly from being compressed in the rows.

Larva—Length, 8mm; color, milky white; apodous; normally arched above, flattened below; transversely wrinkled, there being about three wrinkles dorsally to each joint; also deeply and broadly impressed laterally, the impression being more conspicuous by the folds, each side of it appearing as globular tubercles; sparsely covered with yellowish, setous hairs; head, honey yellow, retractile, nutant, flattened below; mandibles long, strong, dark brown, almost black, 2-toothed; maxillæ with a fringe of long hairs at the end; palpi short, conical, 3-jointed, the terminal joint longest; antennæ rudimentary, represented only by a small tubercle; labium rounded basally, truncate at the tip; labial palpi 2-jointed; a cervical shield, which is highly polished and chitinous, and has a dusky mark near the anterior border and a few dusky spots behind, covers the dorsal portion of the pro- and meso-thoracic joints; stigmata normally placed, all but the first pair being very small, almost imperceptible; largest at the first abdominal joint, tapering very gradually thence to anus; ventrally the setous hairs are shorter but stiffer, those on the thoracic joints being especially stout where the legs would otherwise be.

Pupa—Length, 7mm; color, milky white; head, rostrum, and thoracic joints with a few short, stout bristles; flagellum of the antenna bent at right angles to the scape; wing-sheaths reaching to sixth abdominal joint; anal joint with two short, strong, slightly incurved spines, arising from a fleshy prominence on each outer side, giving to the tip of the body a square aspect; one or more short, stout bristles on the end of each femur, and a transverse row of more minute dorsal hooks on each abdominal joint.

REPORT OF STATISTICIAN.

SIR: My report as statistician of the Department of Agriculture is respectfully submitted.

The system of collecting information and compiling returns used by my predecessors, and which is continued in this report, seems to be the best and only method available for a country embracing an extent of area and variety of climate so great as ours.

The importance of statistical information of agriculture is conceded by all who have given thought to the subject, and has attracted the attention of scholars since the remotest ages; still the difficulty of finding persons who are capable and willing to furnish reliable estimates, the limited amount of appropriation, the lapse of years from one census to another, and the apathy of so many of the States in regard to their own statistics, all tend to make the most careful estimates at times inaccurate.

In fact, the national census never agrees with the State returns. Discrepancies and differences always appear.

THE CROPS OF 1878.

The winter of 1877-'78 was more favorable to cereals planted in the fall than its predecessor, and the aggregate secured this year is greater than in any previous year.

Wheat, which promised so high an average in May, was much affected in the Northwestern States by the heat and drought of June and July. It was less affected in those States where it was fall-planted. The increase of acreage over that of 1877 amounted to nearly 25 per cent., and more than counterbalanced the loss resulting from unfavorable weather in the Northwest. The crop of 1878 reached 420,122,000 bushels.

Corn.—The acreage of corn this year was not materially changed from that of last year. While there was a slight decrease in the great corn-producing States of the Ohio Valley, there was a corresponding increase in the Southern States and those west of the Mississippi River. The cultivated area of last year was somewhat exceeded this year. The heat of July tended rather to increase than diminish the crop; insects did but little damage, and the only injury it sustained was from the protracted drought of midsummer.

The product in the States of Kentucky, Illinois, Missouri, and Kansas shows a decline; in almost all the other corn-producing States there was an increase of yield, thus making a crop of 1,388,218,000 bushels, being an excess over the crop of 1877 of about 45,000,000 bushels. This is the more remarkable as it is the fourth of an unbroken series of large crops.

Cotton.—An estimated increase of acreage for the cotton belt of nearly 2 per cent. was returned for this year. The average condition of the crop during its growth was better than last year, and the weather for maturing and picking was as favorable as could be desired. Complaints of injuries from insects, rust, or blight were less than usual, and, except in small portions of the States of Alabama, Mississippi, and Georgia, were unimportant. The result of this has been a larger crop than the great one of 1877, being 5,200,000 bales of 450 pounds each for this year. As was to have been expected, in the presence of two successive crops of such magnitude, the price has fallen to near 9 cents per pound against 11 cents in 1877, the crop netting the country some $20,000,000 less than that of 1877.

Tobacco.—The acreage for 1878 was 76 per cent. of that of 1877. The quality of tobacco produced was generally heavier and better, making the yield per acre rather more than the previous year, except in Kentucky, where it fell off slightly. The crop of 1878 is estimated at 393,000,000 pounds.

Oats.—The oat crop is somewhat in excess of the very large crop of 1877. The increase of product, however, is less than the increase of acreage, showing that the yield per acre, on the whole, is less than last year. The Atlantic slope, north of the Chesapeake, showed a decline; the Southern coast States uniformly increased their yield; the Western, Northwestern, and Pacific States show a marked increase. The total product reached 413,000,000 bushels.

Barley.—There is no material change in the barley crop for the year 1878, compared with that of 1877, except the great product of California, which will be double its predecessor. The large producing States of New York, Wisconsin, and Illinois each show a decrease in the number of acres sown, and a slight decrease in the yield per acre; while Michigan, Kansas, and Minnesota show an increase in both acreage and yield.

The State of California, which is the largest producing State, increased her acreage from 450,000 to 650,000 acres, and almost doubled her yield per acre. The total product, for the whole country, will be this year, in round numbers, 42,000,000 bushels, while in 1877 the crop was 34,500,000.

Potatoes.—The product of potatoes for 1878 shows a large decline as compared with the crop of 1877. The New England and Middle States fell off nearly one-third, the States north of the Ohio River about one fourth; the States west of the Mississippi River show a decided increase. The average yield this year is only 69 bushels per acre, against 94 in 1877, and the total crop is estimated at 124,000,000 bushels, while that of 1877 was 170,000,000.

Hay.—The conditions of growth in nearly all the States during 1878 were remarkably favorable to grass crops. The result is shown in a hay product over 20 per cent. greater than 1877.

Other Crops.—For details of the other crops, reference is made to the following tables:

Table showing the product of each principal crop of the several States named, the yield per acre, the total acreage, the average price in each State, and the value of each crop for 1878.

Products.	Quantity produced in 1878.	Average yield per acre.	Number of acres in each crop.	Value per bushel, pound, or ton.	Total valuation.
MAINE.					
Indian corn.....bushels..	2, 180, 000	40	54, 500	$0 65	$1, 417, 000
Wheat.....do....	396, 200	14	28, 300	1 31	519, 022
Rye.....do....	42, 400	16	2, 650	87	36, 888
Oats.....do....	2, 667, 000	25. 4	105, 000	38	1, 013, 460
Barley.....do....	817, 300	22	37, 150	71	580, 283
Buckwheat.....do....	432, 000	24	18, 000	54	233, 280
Potatoes.....do....	3, 833, 200	74	51, 800	73	2, 798, 236
Hay.....tons..	1, 260, 000	1	1, 260, 000	9 80	12, 348, 000
Total.....	.....	.....	1, 557, 400	.....	18, 946, 169
NEW HAMPSHIRE.					
Indian corn.....bushels..	2, 207, 400	39	56, 600	61	1, 346, 514
Wheat.....do....	189, 000	14	13, 500	1 48	279, 720
Rye.....do....	39, 600	12	3, 300	76	30, 096
Oats.....do....	1, 313, 760	36. 8	35, 700	36	472, 953
Barley.....do....	96, 600	20	4, 830	69	66, 654
Buckwheat.....do....	107, 000	20	5, 350	55	58, 850
Potatoes.....do....	2, 649, 600	72	36, 800	86	2, 278, 656
Hay.....tons..	637, 000	. 98	650, 000	8 90	5, 669, 300
Total.....	.....	.....	806, 080	.....	10, 202, 743
VERMONT.					
Indian corn.....bushels..	2, 275, 500	41	55, 500	58	1, 319, 790
Wheat.....do...	527, 000	17	31, 000	1 15	606, 050
Rye.....do...	83, 420	19. 4	4, 300	70	58, 394
Oats.....do...	3, 914, 580	31. 8	123, 100	33	1, 291, 811
Barley.....do...	141, 750	27	5, 250	68	96, 390
Buckwheat.....do...	491, 400	27	18, 200	54	265, 356
Potatoes.....do...	2, 721, 600	72	37, 800	75	2, 041, 200
Hay.....tons..	1, 222, 080	1. 14	1, 072, 000	8 85	10, 815, 408
Total.....	.....	.....	1, 347, 150	.....	16, 494, 399
MASSACHUSETTS.					
Indian corn.....bushels..	1, 260, 000	36	35, 000	62	781, 200
Wheat.....do....	18, 260	22	830	1 50	27, 390
Rye.....do....	446, 340	17. 3	25, 800	62	276, 730
Oats.....do....	469, 800	29	16, 200	36	169, 128
Barley.....do....	50, 000	20	2, 500	75	37, 500
Buckwheat.....do....	43, 200	12	3, 600	60	25, 920
Potatoes.....do....	2, 046, 000	60	34, 100	93	1, 902, 780
Tobacco.....pounds..	4, 320, 000	1, 600	2, 700	11	475, 200
Hay.....tons..	884, 450	1. 33	665, 000	13 00	11, 497, 850
Total.....	.....	.....	785, 730	.....	15, 193, 698

Table showing the product of each principal crop, &c., for 1878—Continued.

Products.	Quantity produced in 1878.	Average yield per acre.	Number of acres in each crop.	Value per bushel, pound, or ton.	Total valuation.
RHODE ISLAND.					
Indian corn .... bushels..	268, 800	32	8, 400	$0 53	$142, 464
Rye .... do....	21, 450	13	1, 650	58	12, 441
Oats .... do....	79, 200	24	3, 300	40	31, 680
Barley .... do....	8, 930	19	470	85	7, 590
Potatoes .... do....	513, 500	65	7, 900	1 00	513, 500
Hay .... tons..	116, 000	1	116, 000	18 00	2, 088, 000
Total	....	....	137, 720	....	2, 795, 675
CONNECTICUT.					
Indian corn .... bushels..	2, 220, 000	29. 6	75, 000	62	1, 376, 400
Wheat .... do....	27, 690	13	2, 130	1 02	28, 243
Rye .... do....	443, 040	14. 2	31, 200	85	376, 584
Oats .... do....	1, 298, 080	30. 4	42, 700	39	506, 251
Barley .... do....	26, 400	22	1, 200	70	18, 480
Buckwheat .... do....	118, 300	14	8, 450	73	86, 359
Potatoes .... do....	1, 336, 500	45	29, 700	98	1, 309, 770
Tobacco .... pounds..	8, 120, 000	1, 400	5, 800	11	893, 200
Hay .... tons..	843, 200	1. 60	527, 000	11 45	9, 654, 640
Total	....	....	723, 180	....	14, 249, 927
NEW YORK.					
Indian corn .... bushels..	25, 020, 000	36	695, 000	50	12, 510, 000
Wheat .... do....	14, 128, 400	19	743, 600	1 02	14, 410, 968
Rye .... do....	3, 774, 000	17	222, 000	58	2, 188, 920
Oats .... do....	45, 080, 000	32. 2	1, 400, 000	29	13, 073, 200
Barley .... do....	4, 917, 200	19	258, 800	70	3, 442, 040
Buckwheat .... do....	5, 366, 000	20	268, 300	50	2, 683, 000
Potatoes .... do....	18, 135, 600	51	355, 600	81	14, 689, 836
Tobacco .... pounds..	2, 220, 000	1, 200	1, 850	11	244, 200
Hay .... tons..	6, 480, 000	1. 35	4, 800, 000	7 41	48, 016, 800
Total	....	....	8, 745, 150	....	111, 258, 964
NEW JERSEY.					
Indian corn .... bushels..	9, 792, 000	36	272, 000	45	4, 406, 400
Wheat .... do....	2, 497, 500	15	166, 500	1 06	2, 647, 350
Rye .... do....	564, 740	15. 1	37, 400	60	338, 844
Oats .... do....	5, 224, 800	31. 1	168, 000	29	1, 515, 192
Buckwheat .... do....	374, 300	19	19, 700	54	202, 122
Potatoes .... do....	4, 344, 000	80	54, 300	87	3, 779, 280
Hay .... tons..	681, 500	1. 45	470, 000	10 77	7, 339, 755
Total	....	....	1, 187, 900	....	20, 228, 943
PENNSYLVANIA.					
Indian corn .... bushels..	44, 065, 000	35	1, 259, 000	48	21, 151, 200
Wheat .... do....	22, 095, 000	15	1, 473, 000	97	21, 432, 150
Rye .... do....	3, 777, 620	15. 4	245, 300	84	3, 173, 200
Oats .... do....	37, 778, 400	32. 4	1, 166, 000	27	10, 200, 168
Barley .... do....	677, 300	26	26, 050	80	541, 840
Buckwheat .... do....	2, 720, 000	16	170, 000	55	1, 496, 000
Potatoes .... do....	8, 961, 000	58	154, 500	70	6, 272, 700
Tobacco .... pounds..	22, 800, 000	1, 200	19, 000	10	2, 280, 000
Hay .... tons..	4, 107, 500	1. 55	2, 650, 000	8 06	33, 106, 450
Total	....	....	7, 162, 850	....	99, 653, 708
DELAWARE.					
Indian corn .... bushels..	4, 500, 000	25	180, 000	39	1, 755, 000
Wheat .... do....	1. 043, 900	13	80, 300	1 00	1, 043, 900
Rye .... do....	14, 500	14. 5	1, 000	62	8, 990
Oats .... do....	462, 000	27. 5	16, 800	27	124, 740
Potatoes .... do....	426, 300	87	4, 900	60	255, 780
Hay .... tons..	40, 656	1. 12	36, 300	16 00	650, 496
Total	....	....	319, 300	....	3, 838, 906
MARYLAND.					
Indian corn .... bushels..	11, 209, 500	23. 5	477, 000	45	5, 044, 275
Wheat .... do....	6, 383, 000	13	491, 000	98	6, 255, 340
Rye .... do....	370, 840	14. 6	25, 400	53	196, 545
Oats .... do....	3, 440, 000	20	172, 000	28	963, 200

Table showing the product of each principal crop, &c., for 1878—Continued.

Products.	Quantity produced in 1878.	Average yield per acre.	Number of acres in each crop.	Value per bushel, pound, or ton.	Total valuation.
MARYLAND—Continued.					
Buckwheat ....do....	84, 600	18	4, 700	$0 50	$42, 300
Potatoes ....do....	1, 041, 600	62	16, 800	64	666, 624
Tobacco ....pounds..	29, 750, 000	700	42, 500	5. 5	1, 636, 250
Hay ....tons..	241, 800	1. 24	195, 000	9 75	2, 357, 550
Total....	....	....	1, 424, 400	....	17, 162, 084
VIRGINIA.					
Indian corn ....bushels..	18, 200, 000	17. 5	1, 040, 000	43	7, 826, 000
Wheat ....do....	7, 068, 240	7. 2	981, 700	89	6, 290, 733
Rye ....do....	473, 200	9. 1	52, 000	57	269, 724
Oats ....do....	7, 928, 500	15. 7	505, 000	34	2, 695, 690
Buckwheat ....do....	47, 250	15	3, 150	51	24, 097
Potatoes ....do....	1, 600, 800	87	18, 400	50	800, 400
Tobacco ....pounds..	86, 940, 000	690	126, 000	5	4, 347, 000
Hay ....tons..	285, 600	1. 36	210, 000	12 72	3, 632, 832
Total....	....	....	2, 936, 250	....	25, 886, 476
NORTH CAROLINA.					
Indian corn ....bushels..	22, 603, 200	13. 6	1, 662, 000	45	10, 171, 440
Wheat ....do....	3, 023, 800	6. 5	465, 200	1 00	3, 023, 800
Rye ....do....	354, 410	8. 3	42, 700	66	233, 910
Oats ....do....	4, 448, 000	16	278, 000	43	1, 912, 640
Potatoes ....do....	1, 197, 900	99	12, 100	59	706, 761
Tobacco ....pounds..	12, 896, 000	620	20, 800	6	773, 760
Hay ....tons..	132, 990	1. 43	93, 000	9 68	1, 287, 343
Cotton ....pounds..	99, 794, 500	169	590. 500	8. 5	8, 482, 532
Total....	....	....	3, 164, 300	....	26, 592, 186
SOUTH CAROLINA.					
Indian corn ....bushels..	12, 276, 000	9. 3	1, 320, 000	54	6, 629, 040
Wheat ....do....	732, 050	5. 5	133, 100	1 30	951, 665
Rye ....do....	38, 500	5. 5	7, 000	1 13	43, 505
Oats ....do....	1, 072, 000	13. 4	80, 000	54	578, 880
Potatoes ....do....	99, 600	83	1, 200	74	73, 704
Hay ....tons..	26, 000	1. 30	20, 000	10 85	282, 100
Cotton ....pounds..	153, 977, 950	163	944, 650	8. 7	13, 396, 082
Total....	....	....	2, 505, 950	....	21, 954, 976
GEORGIA.					
Indian corn ....bushels..	24, 398, 000	11	2, 218, 000	61	14, 882, 780
Wheat ....do....	2, 758, 000	7	394, 000	1 18	3, 254, 440
Oats ....do....	7, 154, 280	16. 7	428, 400	55	3, 934, 854
Potatoes ....do....	345, 050	67	5, 150	92	317, 446
Hay ....tons..	39, 790	1. 73	23, 000	13 11	521, 647
Cotton ....pounds..	238, 843, 500	161	1, 483, 500	8. 2	19, 585, 167
Total....	....	....	4, 552, 050	....	42, 496, 334
FLORIDA.					
Indian corn ....bushels..	2, 124, 000	9	236, 000	73	1, 550, 520
Oats ....do....	160, 650	15. 3	10, 500	76	122, 094
Cotton ....pounds..	17, 664, 900	106	166, 650	8. 2	1, 448, 522
Total....	....	....	413, 150	....	3, 121, 136
ALABAMA.					
Indian corn ....bushels..	23, 928, 000	12	1, 994, 000	59	14, 117, 520
Wheat ....do....	1, 255, 600	7. 3	172, 000	1 05	1, 318, 380
Oats ....do....	2, 617, 780	16. 3	160, 600	54	1, 413, 601
Potatoes ....do....	453, 900	102	4, 450	78	354, 042
Hay ....tons..	34, 200	1. 80	19, 000	16 90	577, 980
Cotton ....pounds..	242, 556, 600	132	1, 837, 550	8. 2	19, 889, 641
Total....	....	....	4, 187, 600	....	37, 671, 164
MISSISSIPPI.					
Indian corn ....bushels..	19, 474, 000	13	1, 498, 000	64	12, 463, 360
Wheat ....do....	428, 400	6. 8	63, 000	1 35	578, 340
Oats ....do....	929, 600	16. 6	56, 000	68	632, 128

Table showing the product of each principal crop, &c., for 1878—Continued.

Products.	Quantity produced in 1878.	Average yield per acre.	Number of acres in each crop.	Value per bushel, pound, or ton.	Total valuation.
MISSISSIPPI—Continued.					
Potatoes ....do....	306,600	73	4,200	$0 93	$285,138
Hay ....tons..	27,720	1.54	18,000	15 91	441,025
Cotton ....pounds..	337,028,200	164	2,055,050	8.3	27,973,341
Total........	....	....	3,694,250	....	42,373,332
LOUISIANA.					
Indian corn........bushels..	16,875,200	19.9	848,000	60	10,125,120
Oats ....do....	14,000	14	1,000	59	8,260
Cotton ....pounds..	214,483,050	159	1,348,950	8.3	17,802,093
Sugar........do....	250,000,000	1,700	147,059	5.5	13,750,000
Total........	....	....	2,345,009	....	41,685,473
TEXAS.					
Indian corn........bushels..	58,396,000	26	2,246,000	44	25,694,240
Wheat ....do....	7,200,000	16	450,000	86	6,192,000
Rye........do....	54,000	18	3,000	72	38,880
Oats ....do....	5,531,500	37	149,500	42	2,323,230
Potatoes ....do....	604,800	84	7,200	99	598,752
Hay........tons..	127,200	1.59	80,000	9 75	1,240,200
Cotton ....pounds..	497,310,000	275	1,808,400	8.2	40,779,420
Total........	....	....	4,744,100	....	76,866,722
ARKANSAS.					
Indian corn ....bushels..	22,992,000	24	958,000	48	11,036,160
Wheat ....do....	1,038,000	6	173,000	95	986,100
Rye........ds....	51,040	11.6	4,400	82	41,852
Oats ....do....	1,665,420	24.6	67,700	45	749,439
Potatoes ....do....	992,200	121	8,200	65	644,930
Hay........tons..	24,780	1.77	14,000	12 96	321,149
Cotton ....pounds..	318,277,050	273	1,165,850	8.2	26,098,718
Total........	....	....	2,391,150	....	39,878,348
TENNESSEE.					
Indian corn........bushels..	37,422,700	19.3	1,939,000	41	15,343,307
Wheat ....do....	7,935,000	5	1,587,000	84	6,665,400
Rye........do....	470,400	12	39,200	61	286,944
Oats ....do....	5,707,920	20.4	279,800	33	1,883,613
Buckwheat ....do....	101,650	19	5,350	73	74,204
Potatoes ....do....	1,166,400	72	16,200	39	454,896
Tobacco........pounds..	35,324,800	608	58,100	6	2,119,488
Hay........tons..	174,640	1.48	118,000	10 10	1,763,864
Cotton ....pounds..	196,285,500	265	740,700	8.1	15,899,125
Total........	....	....	4,783,350	....	44,490,841
WEST VIRGINIA.					
Indian corn........bushels..	10,118,400	27.2	372,000	42	4,249,728
Wheat ....do....	3,737,500	11.5	325,000	86	3,214,250
Rye........do....	361,200	14	25,800	53	191,436
Oats ....do....	3,534,600	25.8	137,000	26	918,996
Barley ....do....	42,900	13	3,300	75	32,175
Buckwheat ....do....	86,400	18	4,800	58	50,112
Potatoes ....do....	982,500	75	13,100	44	432,300
Tobacco........pounds..	2,535,000	650	3,900	6.5	164,775
Hay........tons..	341,190	1.53	223,000	6 81	2,323,504
Total........	....	....	1,107,900	....	11,577,276
KENTUCKY.					
Indian corn........bushels..	45,922,100	22.7	2,023,000	40	18,368,840
Wheat ....do....	4,910,400	9.3	528,000	76	3,731,904
Rye........do....	963,960	11.6	83,100	53	510,898
Oats ....do....	7,920,000	26.4	300,000	28	2,217,600
Barley ....do....	375,000	30	12,500	87	326,250
Potatoes ....do....	2,130,000	75	28,400	46	979,800
Tobacco........pounds..	123,453,900	687	179,700	5	6,172,695
Hay........tons..	410,380	1.42	289,000	8 95	3,672,901
Total........	....	....	3,443,700	....	35,980,888

Table showing the product of each principal crop, &c., for 1878—Continued.

Products.	Quantity produced in 1878.	Average yield per acre.	Number of acres in each crop.	Value per bushel, pound, or ton.	Total valuation.
OHIO.					
Indian corn……bushels..	108, 643, 700	34. 9	3, 113, 000	$0 33	$35, 852, 421
Wheat……do…	33, 120, 000	18	1, 840, 000	86	28, 483, 200
Rye……do…	1, 263, 000	17. 8	71, 000	51	644, 538
Oats……do…	32, 848, 500	35. 9	915, 000	22	7, 226, 670
Barley……do…	1, 490, 600	29	51, 400	72	1, 073, 232
Buckwheat……do…	431, 800	17	25, 400	61	263, 398
Potatoes……do…	8, 210, 400	66	124, 400	53	4, 351, 512
Tobacco……pounds..	22, 708, 000	811	28, 000	5	1, 135, 400
Hay……tons..	3, 032, 080	1. 51	2, 008, 000	6 52	19, 769, 162
Total……	……	……	8, 176, 200	……	98, 799, 533
MICHIGAN.					
Indian corn……bushels..	31, 247, 700	37. 4	835, 500	38	11, 874, 126
Wheat……do…	27, 889, 200	18. 3	1, 524, 000	85	23, 705, 820
Rye……do…	285, 600	17	16, 800	48	137, 088
Oats……do…	13, 899, 300	32. 1	433, 000	27	3, 752, 811
Barley……do…	1, 261, 000	26	48, 500	64	807, 040
Buckwheat……do…	676, 000	16. 9	40, 000	48	324, 480
Potatoes……do…	6, 916, 000	76	91, 000	48	3, 319, 680
Hay……tons..	1, 155, 420	1. 31	882, 000	8 49	9, 809, 516
Total……	……	……	3, 870, 800	……	53, 730, 561
INDIANA.					
Indian corn……bushels..	138, 252, 000	32. 8	4, 215, 000	27	37, 328, 040
Wheat……do…	33, 136, 000	16	2, 071, 000	81	26, 840, 160
Rye……do…	435, 000	14. 5	30, 000	51	221, 850
Oats……do…	16, 487, 200	29. 6	557, 000	20	3, 297, 440
Barley……do…	500, 000	25	20, 000	89	445, 000
Buckwheat……do…	135, 520	15. 4	8, 800	60	81, 312
Potatoes……do…	3, 840, 000	64	60, 000	47	1, 804, 800
Tobacco……pounds..	8, 446, 000	820	10, 300	3. 5	295, 610
Hay……tons..	1, 680, 000	1. 40	1, 200, 000	6 06	10, 180, 800
Total……	……	……	8, 172, 100	……	80, 495, 012
ILLINOIS.					
Indian corn……bushels..	225, 932, 700	27. 1	8, 337, 000	25	56, 483, 175
Wheat……do…	31, 620, 000	13. 6	2, 325, 000	75	23, 715, 000
Rye……do…	2, 511, 000	16. 2	155, 000	41	1, 029, 510
Oats……do…	56, 294, 790	35. 9	1, 568, 100	18	10, 133, 062
Barley……do…	1, 936, 600	23	84, 200	53	1, 026, 398
Buckwheat……do…	147, 000	14	10, 500	55	80, 850
Potatoes……do…	9, 339, 800	67	139, 400	46	4, 296, 308
Tobacco……pounds..	5, 180, 000	700	7, 400	4	207, 200
Hay……tons..	3, 531, 300	1. 49	2, 370, 000	5 14	18, 150, 882
Total……	……	……	14, 996, 600	……	115, 122, 385
WISCONSIN.					
Indian corn……bushels..	36, 900, 000	37. 5	984, 000	29	10, 701, 000
Wheat……do…	21, 154, 400	12. 4	1, 706, 000	67	14, 173, 448
Rye……do…	3, 551, 200	18. 4	193, 000	41	1, 455, 992
Oats……do…	33, 528, 000	38. 1	880, 000	20	6, 705, 600
Barley……do…	4, 264, 000	26	164, 000	58	2, 473, 120
Buckwheat……do…	504, 000	15	33, 600	50	252, 000
Potatoes……do…	8, 307, 000	65	127, 800	46	3, 821, 220
Hay……tons..	1, 395, 000	1. 55	900, 000	6 57	9, 165, 150
Total……	……	……	4, 988, 400	……	48, 747, 530
MINNESOTA.					
Indian corn……bushels..	17, 106, 900	38. 1	449, 000	29	4, 961, 001
Wheat……do…	28, 824, 000	12	2, 402, 000	51	14, 700, 240
Rye……do…	176, 800	22. 1	8, 000	41	72, 488
Oats……do…	20, 352, 000	42. 4	480, 000	23	4, 680, 960
Barley……do…	2, 499, 800	29	86, 200	41	1, 024, 918
Buckwheat……do…	102, 200	14. 6	7, 000	54	55, 188
Potatoes……do…	3, 877, 200	108	35, 900	28	1, 085, 616
Hay……tons..	1, 609, 920	1. 72	936, 000	4 73	7, 614, 922
Total……	……	……	4, 404, 100	……	34, 195, 338

Table showing the product of each principal crop, &c., for 1878—Continued.

Products.	Quantity produced in 1878.	Average yield per acre.	Number of acres in each crop.	Value per bushel, pound, or ton.	Total valuation.
IOWA.					
Indian corn .... bushels..	175, 256, 400	37. 4	4, 686, 000	$0 16	$28, 041, 024
Wheat .... do....	30, 440, 960	9. 4	3, 238, 400	50	15, 220, 480
Rye .... do....	431, 600	16. 6	26, 000	35	151, 060
Oats .... do....	38, 332, 800	36. 3	1, 056, 000	13	4, 983, 264
Barley .... do....	5, 088, 000	24	212, 000	33	1, 679, 040
Buckwheat .... do....	123, 200	14	8, 800	51	62, 832
Potatoes .... do....	10, 070, 000	100	100, 700	26	2, 618, 200
Hay .... tons..	3, 564, 000	1. 80	1, 980, 000	3 60	12, 830, 400
Total	....	....	11, 307, 900	....	65, 586, 300
MISSOURI.					
Indian corn .... bushels..	93, 062, 400	26. 2	3, 552, 000	26	24, 196, 224
Wheat .... do....	20, 196, 000	11	1, 836, 000	67	13, 531, 320
Rye .... do....	732, 000	15	48, 800	41	300, 120
Oats .... do....	19, 584, 000	30. 6	640, 000	18	3, 525, 120
Buckwheat .... do....	46, 400	16	2, 900	52	24, 128
Potatoes .... do....	5, 415, 000	75	72, 200	38	2, 057, 700
Tobacco .... pounds..	23, 023, 000	770	29, 900	5	1, 151, 150
Hay .... tons..	1, 620, 000	1. 62	1, 000, 000	6 43	10, 416, 600
Total	....	....	7, 181, 800	....	55, 202, 362
KANSAS.					
Indian corn .... bushels..	81, 563, 400	33. 9	2, 406, 000	19	15, 497, 046
Wheat .... do....	27, 221, 000	16. 3	1, 670, 000	59	16, 060, 390
Rye .... do....	2, 470, 400	19. 3	128, 000	31	765, 824
Oats .... do....	16, 020, 000	36	445, 000	17	2, 723, 400
Barley .... do....	2, 163, 200	26	83, 200	31	670, 592
Buckwheat .... do....	78, 200	17	4, 600	66	51, 612
Potatoes .... do....	4, 539, 000	85	53, 400	44	1, 997, 160
Hay .... tons..	1, 530, 000	1. 80	850, 000	3 27	5, 003, 100
Total	....	....	5, 640, 200	....	42, 769, 124
NEBRASKA.					
Indian corn .... bushels..	54, 222, 000	42	1, 291, 000	16	8, 675, 520
Wheat .... do....	13, 872, 900	13. 1	1, 059, 000	49	6, 797, 721
Rye .... do....	1, 432, 500	19. 1	75, 000	24	343, 800
Oats .... do....	6, 429, 500	33. 4	192, 500	17	1, 093, 015
Barley .... do....	568, 750	25	22, 750	33	187, 687
Buckwheat .... do....	30, 400	16	1, 900	55	16, 720
Potatoes .... do....	1, 750, 000	125	14, 000	23	402, 500
Hay .... tons..	620, 400	1. 88	330, 000	3 29	2, 041, 116
Total	....	....	2, 986, 150	....	19, 558, 079
CALIFORNIA.					
Indian corn .... bushels..	3, 467, 250	34. 5	100, 500	60	2, 080, 350
Wheat .... do....	41, 990, 000	17	2, 470, 000	1 03	43, 249, 700
Rye .... do....	195, 000	15	13, 000	75	146, 250
Oats .... do....	4, 350, 000	30	145, 000	69	3, 001, 500
Barley .... do....	14, 950, 000	23	650, 000	65	9, 717, 500
Potatoes .... do....	4, 377, 600	114	38, 400	98	4, 290, 048
Hay .... tons..	1, 271, 000	2. 05	620, 000	12 61	16, 027, 310
Total	....	....	4, 036, 900	....	78, 512, 658
OREGON.					
Indian corn .... bushels..	166, 500	33. 3	5, 000	92	153, 180
Wheat .... do....	7, 665, 000	21	365, 000	92	7, 051, 800
Rye .... do....	13, 230	14. 7	900	72	9, 525
Oats .... do....	2, 790, 000	31	90, 000	50	1, 395, 000
Barley .... do....	370, 300	23	16, 100	62	229, 586
Potatoes .... do....	598, 500	95	6, 300	60	359, 100
Hay .... tons..	160, 500	1. 50	107, 000	12 00	1, 926, 000
Total	....	....	590, 300	....	11, 124, 191

Table showing the product of each principal crop, &c., for 1878—Continued.

Products.	Quantity produced in 1878.	Average yield per acre.	Number of acres in each crop.	Value per bushel, pound, or ton.	Total valuation.
NEVADA, COLORADO, AND THE TERRITORIES.					
Indian corn .... bushels..	2, 670, 000	30	89, 000	$0 60	$1, 602, 000
Wheat .... do....	15, 600, 000	12	1, 300, 000	60	9, 360, 000
Oats .... do....	2, 250, 600	31	72, 600	30	675, 180
Potatoes .... do....	997, 500	95	10, 500	50	498, 750
Tobacco .... pounds..	4, 830, 000	700	6, 900	5	241, 500
Hay .... tons..	300, 000	1. 50	200, 000	10 00	3, 000, 000
Cotton .... pounds..	31, 250, 000	250	125, 000	8	2, 500, 000
Total	....	....	1, 804, 000	....	17, 877, 430

Summary for each State, showing the product, the area, and the value of each crop for 1878.

States.	Corn.			Wheat.			Rye.		
	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.
Maine	2, 180, 000	54, 500	$1, 417, 000	396, 200	28, 300	$519, 022	42, 400	2, 650	$36, 888
New Hampshire	2, 207, 400	56, 600	1, 346, 514	189, 000	13, 500	279, 720	39, 600	3, 300	30, 096
Vermont	2, 275, 500	55, 500	1, 319, 790	527, 000	31, 000	606, 050	83, 420	4, 300	58, 394
Massachusetts	1, 260, 000	35, 000	781, 200	13, 260	830	27, 390	446, 340	25, 800	276, 730
Rhode Island	268, 800	8, 400	142, 464	....	....	....	21, 450	1, 650	12, 441
Connecticut	2, 220, 000	75, 000	1, 376, 400	27, 690	2, 130	28, 243	443, 040	31, 200	376, 584
New York	25, 020, 000	695, 000	12, 510, 000	14, 123, 400	743, 600	14, 410, 968	3, 774, 000	222, 000	2, 188, 920
New Jersey	9, 792, 000	272, 000	4, 406, 400	2, 497, 500	166, 500	2, 647, 350	564, 740	37, 400	338, 844
Pennsylvania	44, 065, 000	1, 259, 000	21, 151, 200	22, 095, 000	1, 473, 000	21, 432, 150	3, 777, 620	245, 300	3, 173, 200
Delaware	4, 500, 000	180, 000	1, 755, 000	1, 043, 900	80, 300	1, 043, 900	14, 500	1, 000	8, 990
Maryland	11, 209, 500	477, 000	5, 044, 275	6, 383, 000	491, 000	6, 255, 340	370, 840	25, 400	196, 545
Virginia	18, 200, 000	1, 040, 000	7, 826, 000	7, 068, 240	981, 700	6, 290, 733	473, 200	52, 000	269, 724
North Carolina	22, 603, 200	1, 662, 000	10, 171, 440	3, 023, 800	465, 200	3, 023, 800	354, 410	42, 700	233, 910
South Carolina	12, 276, 000	1, 320, 000	6, 629, 040	732, 050	133, 100	951, 665	38, 500	7, 000	43, 505
Georgia	24, 398, 000	2, 218, 000	14, 882, 780	2, 758, 000	394, 000	3, 254, 440	....	....	....
Florida	2, 124, 000	236, 000	1, 550, 520	....	....	....	....	....	....
Alabama	23, 928, 000	1, 994, 000	14, 117, 520	1, 255, 600	172, 000	1, 318, 380	....	....	....
Mississippi	19, 474, 000	1, 498, 000	12, 463, 360	428, 400	63, 000	578, 340	....	....	....
Louisiana	16, 875, 200	848, 000	10, 125, 120	....	....	....	....	....	....
Texas	58, 396, 000	2, 246, 000	25, 694, 240	7, 200, 000	450, 000	6, 192, 000	54, 000	3, 000	38, 880
Arkansas	22, 992, 000	958, 000	11, 036, 160	1, 038, 000	173, 000	986, 100	51, 040	4, 400	41, 852
Tennessee	37, 422, 700	1, 939, 000	15, 343, 307	7, 935, 000	1, 587, 000	6, 665, 400	470, 400	39, 200	286, 944
West Virginia	10, 118, 400	372, 000	4, 249, 728	3, 737, 500	325, 000	3, 214, 250	361, 200	25, 800	191, 436
Kentucky	45, 922, 100	2, 023, 000	18, 368, 840	4, 910, 400	528, 000	3, 731, 904	963, 960	83, 100	510, 898
Ohio	108, 643, 700	3, 113, 000	35, 852, 421	33, 120, 000	1, 840, 000	28, 483, 200	1, 263, 800	71, 000	644, 598
Michigan	31, 247, 700	835, 500	11, 874, 126	27, 889, 200	1, 524, 000	23, 705, 820	285, 600	16, 800	137, 088
Indiana	138, 252, 000	4, 215, 000	37, 328, 040	33, 136, 000	2, 071, 000	26, 840, 160	435, 000	30, 000	221, 850
Illinois	225, 932, 700	8, 337, 000	56, 483, 175	31, 620, 000	2, 325, 000	23, 715, 000	2, 511, 000	155, 000	1, 029, 510
Wisconsin	36, 900, 000	984, 000	10, 701, 000	21, 154, 400	1, 706, 000	14, 173, 448	3, 551, 200	193, 000	1, 455, 992
Minnesota	17, 166, 900	449, 000	4, 961, 001	28, 824, 000	2, 402, 000	14, 700, 240	176, 800	8, 000	72, 488
Iowa	175, 256, 400	4, 686, 000	28, 041, 024	30, 440, 960	3, 238, 400	15, 220, 480	431, 600	26, 000	151, 060
Missouri	93, 062, 400	3, 552, 000	24, 196, 224	20, 196, 000	1, 836, 000	13, 531, 320	732, 000	48, 800	300, 120
Kansas	81, 563, 400	2, 406, 000	15, 497, 046	27, 221, 000	1, 670, 000	16, 060, 390	2, 470, 400	128, 000	765, 824
Nebraska	54, 222, 000	1, 291, 000	8, 675, 520	13, 872, 900	1, 059, 000	6, 797, 721	1, 432, 500	75, 000	343, 800
California	3, 467, 250	100, 500	2, 080, 350	41, 990, 000	2, 470, 000	43, 249, 700	195, 000	13, 000	146, 250
Oregon	166, 500	5, 000	153, 130	7, 665, 000	365, 000	7, 051, 800	13, 230	900	9, 525
Nevada, Colorado, and the Territories	2, 670, 000	89, 000	1, 602, 000	15, 600, 000	1, 300, 000	9, 360, 000	....	....	....
Total	1,388,218,750	51, 585, 000	441, 153, 405	420, 122, 400	32, 108, 560	326, 346, 424	25, 842, 790	1, 622, 700	13, 592, 826

Summary for each State, showing the product, the area, and the value of each crop for 1878—Continued.

States.	Oats.			Barley.			Buckwheat.		
	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.
Maine	2, 667, 000	105, 000	$1, 013, 460	817, 300	37, 150	$580, 283	432, 000	18, 000	$233, 280
New Hampshire	1, 313, 760	35, 700	472, 953	96, 600	4, 830	66, 654	107, 000	5, 350	58, 850
Vermont	3, 914, 580	123, 100	1, 291, 811	141, 750	5, 250	96, 390	491, 400	18, 200	265, 356
Massachusetts	469, 800	16, 200	169, 128	50, 000	2, 500	37, 500	43, 200	3, 600	25, 920
Rhode Island	79, 200	3, 300	31, 680	8, 930	470	7. 590			
Connecticut	1, 298, 080	42, 700	506, 251	26, 400	1, 200	18, 480	118, 300	8, 450	86, 359
New York	45, 080, 000	1, 400, 000	13, 073, 200	4, 917, 200	258, 800	3, 442, 040	5, 366, 000	268, 300	2, 683, 000
New Jersey	5, 224, 800	168, 000	1, 515, 192				374, 300	19, 700	202, 122
Pennsylvania	37, 778, 400	1, 166, 000	10, 200, 168	677, 300	26, 050	541, 840	2, 720, 000	170, 000	1, 496, 000
Delaware	462, 000	16, 800	124, 740						
Maryland	3, 440, 000	172, 000	963, 200				84, 600	4, 700	42, 300
Virginia	7, 928, 500	505, 000	2, 695, 690				47, 250	3, 150	24, 097
North Carolina	4, 448, 000	278, 000	1, 912, 640						
South Carolina	1, 072, 000	80, 000	578, 880						
Georgia	7, 154, 280	428, 400	3, 934, 854						
Florida	160, 650	10, 500	122, 094						
Alabama	2, 617, 780	160, 600	1, 413, 601						
Mississippi	929, 600	56, 000	632, 128						
Louisiana	14, 000	1, 000	8, 260						
Texas	5, 531, 500	149, 500	2, 323, 230						
Arkansas	1, 665, 420	67, 700	749, 439						
Tennessee	5, 707, 920	279, 800	1, 883, 613				101, 650	5, 350	74, 204
West Virginia	3, 534, 600	137, 000	918, 996	42, 900	3, 300	32, 175	86, 400	4, 800	50, 112
Kentucky	7, 920, 000	300, 000	2, 217, 600	375, 000	12, 500	320, 250			
Ohio	32, 848, 500	915, 000	7, 226, 670	1, 490, 600	51, 400	1, 073, 232	431, 800	25, 400	263, 398
Michigan	13, 899, 300	433, 000	3, 752, 811	1, 261, 000	48, 500	807, 040	676, 000	40, 000	324, 480
Indiana	16, 487, 200	557, 000	3, 297, 440	500, 000	20, 000	445, 000	135, 520	8, 800	81, 312
Illinois	56, 294, 790	1, 568, 100	10, 133, 062	1, 936, 600	84, 200	1, 026, 398	147, 000	10, 500	80, 850
Wisconsin	33, 528, 000	880, 000	6, 705, 600	4, 264, 000	164, 000	2, 473, 120	504, 000	33, 600	252, 000
Minnesota	20, 352, 000	480, 000	4, 680, 960	2, 499, 800	86, 200	1, 024, 918	102, 200	7, 000	55, 188
Iowa	38, 332, 800	1, 056, 000	4, 983, 264	5, 088, 000	212. 000	1, 679, 040	123, 200	8, 800	62, 832
Missouri	19, 584, 000	640, 000	3, 525, 120				46, 400	2. 900	24, 128
Kansas	16, 020, 000	445, 000	2, 723, 400	2, 163, 200	83, 200	670, 592	78, 200	4, 600	51, 612
Nebraska	6, 429, 500	192, 500	1, 093, 015	568, 750	22, 750	187, 687	30, 400	1, 900	16, 720
California	4, 350, 000	145, 000	3, 001, 500	14, 950, 000	650, 000	9, 717, 500			
Oregon	2, 790, 000	90, 000	1, 395, 000	370, 800	16, 100	229, 586			
Nevada, Colorado, and the Territories	2, 250, 600	72, 600	675, 180						
Total	413, 578, 560	13, 176, 500	101, 945, 830	42, 245, 630	1, 790, 400	24, 483, 315	12, 246, 820	673, 100	6, 454, 120

Summary for each State, showing the product, the area, and the value of each crop for 1878—Concluded.

STATES.	POTATOES.			TOBACCO.			HAY.			COTTON.		
	Bushels.	Acres.	Value.	Pounds.	Acres.	Value.	Tons.	Acres.	Value.	Pounds.	Acres.	Value.
Maine	3, 833, 200	51, 800	$2, 798, 236				1, 260, 000	1, 260, 000	$12, 348, 000			
New Hampshire	2, 649, 600	36, 800	2, 278, 656				637, 000	650, 000	5, 669, 300			
Vermont	2, 721, 600	37, 800	2, 041, 200				1, 222, 080	1, 072, 000	10, 815, 408			
Massachusetts	2, 046, 000	34, 100	1, 902, 780	4, 320, 000	2, 700	$475, 200	884, 450	665, 000	11, 497, 850			
Rhode Island	513, 500	7, 900	513, 500				116, 000	116, 000	2, 088, 000			
Connecticut	1, 336, 500	29, 700	1, 309, 770	8, 120, 000	5, 800	893, 200	843, 200	527, 000	9, 654, 640			
New York	18, 135, 600	355, 600	14, 689, 836	2, 220, 000	1, 850	244, 200	6, 480, 000	4, 800, 000	48, 016, 800			
New Jersey	4, 344, 000	54, 300	3, 779, 280				681, 500	470, 000	7, 339, 755			
Pennsylvania	8, 961, 000	154, 500	6, 272, 700	22, 800, 000	19, 000	2, 280, 000	4, 107, 500	2, 650, 000	33, 106, 450			
Delaware	426, 300	4, 900	255, 780				40, 656	36, 300	650, 496			
Maryland	1, 041, 600	16, 800	666, 624	29, 750, 000	42, 500	1, 636, 250	241, 800	195, 000	2, 357, 550			
Virginia	1, 600, 800	18, 400	800, 400	86, 940, 000	126, 000	4, 347, 000	285, 600	210, 000	3, 632, 832			
North Carolina	1, 197, 900	12, 100	706, 761	12, 896, 000	20, 800	773, 760	132, 990	93, 000	1, 287, 343	99, 794, 500	590, 500	$8, 482, 532
South Carolina	99, 600	1, 200	73, 704				26, 000	20, 000	282, 100	153, 977, 950	944, 650	13, 396, 082
Georgia	345, 050	5, 150	317, 446				39, 790	23, 000	521, 647	238, 843, 500	1, 483, 500	10, 585, 167
Florida										17, 664, 900	166, 650	1, 448, 522
Alabama	453, 900	4, 450	354, 042				34, 200	19, 000	577, 980	242, 556, 600	1, 837, 550	19, 889, 641
Mississippi	306, 600	4, 200	285, 138				27, 720	18, 000	441, 025	337, 028, 200	2, 055, 050	27, 973, 341
Louisiana										214, 483, 050	1, 348, 950	17, 802, 093
Texas	604, 800	7, 200	598, 752				127, 200	80, 000	1, 240, 200	497, 310, 000	1, 808, 400	40, 779, 420
Arkansas	992, 200	8, 200	644, 930				24, 780	14, 000	321, 149	318, 277, 050	1, 165, 850	26, 098, 718
Tennessee	1, 166, 400	16, 200	454, 896	35, 324, 800	58, 100	2, 119, 488	174, 640	118, 000	1, 763, 864	196, 285, 500	740, 700	15, 899, 125
West Virginia	982, 500	13, 100	432, 300	2, 535, 000	3, 900	164, 775	341, 190	223, 000	2, 323, 504			
Kentucky	2, 130, 000	28, 400	979, 800	123, 453, 900	179, 700	6, 172, 695	410, 380	289, 000	3, 672, 901			
Ohio	8, 210, 400	124, 400	4, 351, 512	22, 708, 000	28, 000	1, 135, 400	3, 032, 080	2, 008, 000	19, 769, 162			
Michigan	6, 916, 000	91, 000	3, 319, 680				1, 155, 420	882, 000	9, 809, 516			
Indiana	3, 840, 000	60, 000	1, 804, 800	8, 446, 000	10, 300	295, 610	1, 680, 000	1, 200, 000	10, 180, 800			
Illinois	9, 339, 800	139, 400	4 296, 308	5, 180, 000	7, 400	207, 200	3, 531, 300	2, 370, 000	18, 150, 882			
Wisconsin	8, 307, 000	127, 800	3, 821, 220				1, 395, 000	900, 000	9, 165, 150			
Minnesota	3, 877, 200	35, 900	1, 085, 616				1, 609, 920	936, 000	7, 614, 922			
Iowa	10, 070, 000	100, 700	2, 618, 200				3, 564, 000	1, 980, 000	12, 830, 400			
Missouri	5, 415, 000	72, 200	2, 057, 700	23, 023, 000	29, 900	1, 151, 150	1, 620, 000	1, 000, 000	10, 416, 600			
Kansas	4, 539, 000	53, 400	1, 997, 160				1, 530, 000	850, 000	5, 003, 100			
Nebraska	1, 750, 000	14, 000	402, 500				620, 400	330, 000	2, 041, 116			
California	4, 377, 600	38, 400	4, 290, 048				1, 271, 000	620, 000	16, 027, 310			
Oregon	598, 500	6, 300	359, 100				160, 500	107, 000	1, 926, 000			
Nevada, Colorado, and the Territories	997, 500	10, 500	498, 750	*4, 830, 000	6, 900	241, 500	300, 000	200, 000	3, 000, 000	†31, 250, 000	125, 000	2, 500, 000
Total	124, 126, 650	1, 776, 800	73, 059, 125	392, 546, 700	542, 850	22, 137, 428	39, 608, 296	26, 931, 300	285, 543, 752	‡2, 347, 471, 250	12, 266, 800	193, 854, 641

* This amount includes an aggregate estimate of the tobacco crop of States left blank in the column above.

† Produced chiefly in Indian Territory.

‡ 5,216,603 bales of 450 pounds each.

Table showing the average yield per acre and the price per bushel, pound, or ton, of farm products for the year 1878.

STATES.	CORN.		WHEAT.		RYE.		OATS.		BARLEY.		BUCKWHEAT.		POTATOES.		TOBACCO.		HAY.		COTTON.	
	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Pounds.	Price per pound.	Tons.	Price per ton.	Pounds.	Price per pound.
Maine	40	$0 65	14	$1 31	16	$0 87	25.4	$0 38	22	$0 71	24	$0 54	74	$0 73	......	......	1	$9 80	......	......
New Hampshire	39	61	14	1 48	12	76	36.8	36	20	69	20	55	72	86	......	......	.98	8 90	......	......
Vermont	41	58	17	1 15	19.4	70	31.8	33	27	68	27	54	72	75	......	......	1.14	8 85	......	......
Massachusetts	36	62	22	1 50	17.3	62	29	36	20	75	12	60	60	93	1,600	$0 11	1.33	13 00	......	......
Rhode Island	32	53	......	......	13	58	24	40	19	85	......	......	65	1 00	......	......	1	18 00	......	......
Connecticut	29.6	62	13	1 02	14.2	85	30.4	39	22	70	14	73	45	98	1,400	11	1.60	11 45	......	......
New York	36	50	19	1 02	17	58	32.2	29	19	70	20	50	51	81	1,200	11	1.35	7 41	......	......
New Jersey	36	45	15	1 06	15.1	60	31.1	29	......	......	19	54	80	87	......	......	1.45	10 77	......	......
Pennsylvania	35	48	15	97	15.4	84	32.4	27	26	80	16	55	58	70	1,200	10	1.55	8 06	......	......
Delaware	25	39	13	1 00	14.5	62	27.5	27	......	......	......	......	87	60	......	......	1.12	16 00	......	......
Maryland	23.5	45	13	98	14.6	53	20	28	......	......	18	50	62	64	700	5.5	1.24	9 75	......	......
Virginia	17.5	43	7.2	89	9.1	57	15.7	34	......	......	15	51	87	50	690	5	1.36	12 72	......	......
North Carolina	13.6	45	6.5	1 00	8.3	66	16	43	......	......	......	......	99	59	620	6	1.43	9 68	169	$0 08.5
South Carolina	9.3	54	5.5	1 30	5.5	1 13	13.4	54	......	......	......	......	83	74	......	......	1.30	10 85	163	8.7
Georgia	11	61	7	1 18	......	......	16.7	55	......	......	......	......	67	92	......	......	1.73	13 11	161	8.2
Florida	9	73	......	......	......	......	15.3	76	......	......	......	......	......	......	......	......	......	......	106	8.2
Alabama	12	59	7.3	1 05	......	......	16.3	54	......	......	......	......	102	78	......	......	1.80	16 90	132	8.2
Mississippi	13	64	6.8	1 35	......	......	16.6	68	......	......	......	......	73	93	......	......	1.54	15 91	164	8.3
Louisiana	19.9	60	......	......	......	......	14	59	......	......	......	......	......	......	......	......	......	......	159	8.3
Texas	26	44	16	86	18	72	37	42	......	......	......	......	84	99	......	......	1.59	9 75	275	8.2
Arkansas	24	48	6	95	11.6	82	24.6	45	......	......	......	......	121	65	......	......	1.77	12 96	273	8.2
Tennessee	19.3	41	5	84	12	61	20.4	33	......	......	19	73	72	39	608	6	1.48	10 10	265	8.1
West Virginia	27.2	42	11.5	86	14	53	25.8	26	13	75	18	58	75	44	650	6.5	1.53	6 81	......	......
Kentucky	22.7	40	9.3	76	11.6	53	26.4	28	30	87	......	......	75	46	687	5	1.42	8 95	......	......
Ohio	34.9	33	18	86	17.8	51	35.9	22	29	72	17	61	66	53	811	5	1.51	6 52	......	......
Michigan	37.4	38	18.3	85	17	48	32.1	27	26	64	16.9	48	76	48	......	......	1.31	8 49	......	......
Indiana	32.8	27	16	81	14.5	51	29.6	20	25	89	15.4	60	64	47	820	3.5	1.40	6 06	......	......
Illinois	27.1	25	13.6	75	16.2	41	35.9	18	23	53	14	55	67	46	700	4	1.49	5 14	......	......
Wisconsin	37.5	29	12.4	67	18.4	41	38.1	20	26	58	15	50	65	46	......	......	1.55	6 57	......	......
Minnesota	38.1	29	12	51	22.1	41	42.4	23	29	41	14.6	54	108	28	......	......	1.72	4 73	......	......
Iowa	37.4	16	9.4	50	16.6	35	36.3	13	24	33	14	51	100	26	......	......	1.80	3 60	......	......
Missouri	26.2	26	11	67	15	41	30.6	18	......	......	16	52	75	38	770	5	1.62	6 43	......	......
Kansas	33.9	19	16.3	59	19.3	31	36	17	26	31	17	66	85	44	......	......	1.80	3 27	......	......
Nebraska	42	16	13.1	49	19.1	24	33.4	17	25	33	16	55	125	23	......	......	1.88	3 29	......	......
California	34.5	60	17	1 03	15	75	30	69	23	65	......	......	114	98	......	......	2.05	12 61	......	......
Oregon	33.3	92	21	92	14.7	72	31	50	23	62	......	......	95	60	......	......	1.50	12 00	......	......
Nevada, Colorado, and the Territories	30	60	12	60	......	......	31	30	......	......	......	......	95	50	700	5	1.50	10 00	250	8

The prices in the above table are those at the home markets on December 1, 1878.

Table showing the average cash value per acre of farm products for the year 1878.

States.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Tobacco.	Hay.	Cotton.
Maine	$26 00	$18 34	$13 92	$9 65	$15 62	$12 96	$54 02	....	$9 80	......
New Hampshire	23 79	20 72	9 12	13 25	13 80	11 00	61 92	....	8 72	......
Vermont	23 78	19 55	13 58	10 49	18 36	14 58	54 00	....	10 09	......
Massachusetts	22 32	33 00	10 73	10 44	15 00	7 20	55 80	$176 00	17 29	......
Rhode Island	16 96	......	7 54	9 60	16 15	......	65 00	....	18 00	......
Connecticut	18 35	13 26	12 07	11 86	15 40	10 22	44 10	154 00	18 32	......
New York	13 00	19 38	9 86	9 34	13 30	10 00	41 31	132 00	10 00	......
New Jersey	16 20	15 90	9 06	9 02	......	10 26	69 60	....	15 62	......
Pennsylvania	16 80	14 55	12 94	8 75	20 80	8 80	40 60	120 00	12 49	......
Delaware	9 75	13 00	8 99	7 42	......	......	52 20	....	17 92	......
Maryland	10 57	12 74	7 74	5 60	......	9 00	39 68	38 50	12 09	......
Virginia	7 52	6 41	5 19	5 34	......	7 65	43 50	34 50	17 30	......
North Carolina	6 12	6 50	5 48	6 88	......	......	58 41	37 20	13 84	$14 36
South Carolina	5 02	7 15	6 21	7 24	......	......	61 42	....	14 10	14 18
Georgia	6 71	6 26	......	9 18	......	......	61 64	....	22 68	13 20
Florida	6 57	......	......	11 63	......	......	......	....	......	8 69
Alabama	7 08	7 66	......	8 80	......	......	79 56	....	30 42	10 82
Mississippi	8 32	9 18	......	11 29	......	......	67 89	....	24 50	13 61
Louisiana	11 94	......	......	8 26	......	......	......	....	......	13 20
Texas	11 44	13 76	12 96	15 54	......	......	83 16	....	15 50	22 55
Arkansas	11 52	5 70	9 51	11 07	......	......	78 65	....	22 94	22 39
Tennessee	7 91	4 20	7 32	6 73	......	13 87	28 08	36 48	14 95	21 46
West Virginia	11 42	9 89	7 42	6 71	9 75	10 44	33 00	42 25	10 42	......
Kentucky	9 08	7 07	6 15	7 39	26 10	......	34 50	34 35	12 71	......
Ohio	11 52	15 48	9 08	7 90	20 88	10 37	34 98	40 55	9 85	......
Michigan	14 21	15 55	8 16	8 67	16 64	8 11	36 48	....	11 12	......
Indiana	8 86	12 96	7 39	5 92	22 25	9 24	30 08	28 70	8 48	......
Illinois	6 77	10 20	6 64	6 46	12 19	7 70	30 82	28 00	7 66	......
Wisconsin	10 87	8 31	7 54	7 62	15 08	7 50	29 90	....	10 18	......
Minnesota	11 05	6 12	9 06	9 75	11 89	7 88	30 24	....	8 14	......
Iowa	5 98	4 70	5 81	4 72	7 92	7 14	26 00	....	6 48	......
Missouri	6 81	7 37	6 15	5 51	......	8 32	28 50	38 50	10 42	......
Kansas	6 44	9 62	5 98	6 12	8 06	11 22	37 40	....	5 89	......
Nebraska	6 72	6 42	4 58	5 63	8 25	8 80	28 75	....	6 19	......
California	20 70	17 51	11 25	20 70	14 95	......	111 72	....	25 85	......
Oregon	30 64	19 32	10 58	15 50	14 26	......	57 00	....	18 00	......
Nevada, Colorado, and the Territories	18 00	7 20	......	9 30	......	......	47 50	35 00	15 00	20 00

Table showing the average cash value per acre of the principal crops of the farm taken together for the year 1878.

States.	Average value per acre.	States.	Average value per acre.
Maine	$12 17	Texas	$16 20
New Hampshire	12 66	Arkansas	16 68
Vermont	12 24	Tennessee	9 30
Massachusetts	19 34	West Virginia	10 45
Rhode Island	20 30	Kentucky	10 45
Connecticut	19 70	Ohio	12 08
New York	12 72	Michigan	13 88
New Jersey	17 03	Indiana	9 85
Pennsylvania	13 91	Illinois	7 68
Delaware	12 02	Wisconsin	9 77
Maryland	12 05	Minnesota	7 76
Virginia	8 82	Iowa	5 80
North Carolina	8 40	Missouri	7 69
South Carolina	8 76	Kansas	7 58
Georgia	9 34	Nebraska	6 55
Florida	7 55	California	19 45
Alabama	9 00	Oregon	18 84
Mississippi	11 47	Nevada, Colorado, and the Territories	9 91
Louisiana	17 78		

A general summary, showing the estimated quantities, number of acres, and aggregate value of the principal crops of the farm in 1878.

Products.	Number of bushels, &c.	Number of acres.	Value.
Indian corn.....bushels..	1,388,218,750	51,585,000	$441,153,405
Wheat.....do....	420,122,400	32,108,560	326,346,424
Rye.....do....	25,842,790	1,622,700	13,592,826
Oats.....do....	413,578,560	13,176,500	101,945,830
Barley.....do....	42,245,630	1,790,400	24,483,315
Buckwheat.....do....	12,246,820	673,100	6,454,120
Potatoes.....do....	124,126,650	1,776,800	73,059,125
Total.....	2,426,381,600	102,733,060	987,035,045
Tobacco.....pounds..	392,546,700	542,850	22,137,428
Hay.....tons..	39,608,296	26,931,300	285,543,752
Cotton.....bales of 450 pounds..	5,216,603	12,266,800	193,854,641
Grand total.....	.....	142,474,010	1,488,570,866

Table showing the average yield and cash value per acre, and price per bushel, pound, or ton, of farm products for the year 1878.

Products.	Average yield per acre.	Average price per bushel.	Average value per acre.	Products.	Average yield per acre.	Average price per bushel, pound, or ton.	Average value per acre.
Indian corn ...bushels.	26.9+	$0 31.8—	$8 55	Buckwheat..bushels..	18.2 —	$0 52.7+	$9 59
Wheat.....do..	13.1—	77.7—	10 16	Potatoes..... do....	69.9 —	58.9—	41 12
Rye.....do..	15.9+	52.6—	8 38	Tobacco.....pounds..	723.1 +	5.6+	40 78
Oats.....do..	31.4—	24.6+	7 74	Hay.....tons..	1.47+	7 20.9+	10 60
Barley.....do..	23.6—	58.0—	13 67	Cotton.....pounds..	191.4 —	08.3—	15 80

CONDITION OF FARM ANIMALS.

The condition of farm animals for the year 1878 has on the whole been favorable. As the natural result of the exceptionally mild winter of 1877-'78, coupled with an abundant and cheap supply of provender, all kinds of stock came forth from winter quarters the past spring in better flesh and greater vigor than have obtained for several years.

In many of the States, in pastures usually covered with snow, grazing was uninterrupted throughout the winter; and even from the more northern States few reports were received of disaster to cattle from the severe cold and violent storms so prevalent in those high latitudes.

As a further result of the open winter, lung disease, epizootic, and similar disorders, were almost unheard of; and what is more important the gestation of all animals was more general and the offspring better developed. From this one fact the farmers and stock raisers of the country may learn, if they do not already know, that they will always find their account in keeping their breeding animals in a thriving, healthy condition, not overfat, but pinched at no time by hunger, nor left to shake unsheltered in the blasts of winter and the no less chilling winds and rain of early spring.

NUMBER OF FARM ANIMALS.

The estimate of numbers of farm animals shows a material increase during the past three years; the largest gain being in swine. In sheep, the largest increase has occurred in Texas, Kansas, and Nebraska. Sep

arate estimates are not given for the Territories; it being impossible, from the rapid changes occurring, and the want of an adequate corps of correspondents, to obtain exact data. The numbers for the whole countrp foot up as follows:

	January, 1877.	January, 1878.	January, 1879.
Horses	10, 155, 400	10, 611, 500	10, 938, 700
Mules	1, 443, 500	1, 684, 200	1, 713, 100
Milch-cows	11, 260, 800	11, 432, 300	11, 826, 400
Oxen and other cattle	17, 956, 100	20, 420, 000	21, 408, 100
Sheep	35, 804, 200	36, 575, 900	38, 123, 800
Swine	28, 077, 100	32, 262, 400	34, 766, 100
Total	104, 697, 100	112, 986, 300	118, 776, 200

PRICES OF FARM ANIMALS.

A decline is to be noted in the prices of all kinds of farm animals for the same period. The average per capita for the whole country and for all ages is as follows:

	January, 1877.	January, 1878.	January, 1879.
Horses	$60 08	$58 16	$52 41
Mules	68 91	63 70	56 06
Milch-cows	27 32	26 41	21 73
Oxen and other cattle	17 10	17 14	15 39
Sheep	2 27	2 25	2 07
Swine	6 09	4 98	3 18

Table showing the estimated total number and total value of each kind of live stock and the average price in January, 1879.

States.	Horses.			Mules.			Milch-cows.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	81, 700	$56 97	$4, 654, 449	....	....	....	169, 100	$22 70	$3, 838, 570
New Hampshire	57, 100	56 39	3, 219, 869	....	....	....	98, 100	26 28	2, 578, 068
Vermont	77, 400	57 96	4, 486, 104	....	....	....	217, 800	25 00	5, 445, 000
Massachusetts	131, 000	79 40	10, 401, 400	....	....	....	160, 700	32 50	5, 222, 750
Rhode Island	16, 200	67 50	1, 093, 500	....	....	....	22, 000	33 00	726, 000
Connecticut	53, 500	59 00	3, 156, 500	....	....	....	116, 500	29 50	3, 436, 750
New York	898, 900	71 93	64, 657, 877	11, 800	$83 59	$986, 362	1, 446, 200	23 37	33, 797, 694
New Jersey	114, 500	85 03	9, 735, 935	14, 400	104 27	1, 501, 488	152, 200	35 46	5, 397, 012
Pennsylvania	614, 500	66 29	40, 735, 205	24, 900	79 82	1, 987, 518	828, 400	20 26	16, 783, 384
Delaware	19, 900	74 97	1, 491, 903	4, 000	84 35	337, 400	23, 200	26 00	603, 200
Maryland	108, 600	64 67	7, 023, 162	11, 300	85 14	962, 082	100, 500	25 73	2, 585, 865
Virginia	208, 700	52 70	10, 998, 490	30, 600	63 48	1, 942, 488	238, 200	17 89	4, 261, 398
North Carolina	145, 200	56 60	8, 218, 320	74, 000	60 19	4, 454, 060	232, 300	22 22	5, 161, 706
South Carolina	59, 600	79 87	4, 760, 252	51, 500	79 57	4, 097, 855	131, 300	13 41	1, 760, 733
Georgia	119, 200	61 61	7, 343, 912	97, 200	71 86	6, 984, 792	273, 100	13 98	3, 817, 938
Florida	22, 400	58 46	1, 309, 504	11, 900	66 36	789, 684	70, 000	12 62	883, 400
Alabama	112, 800	54 12	6, 104, 736	111, 700	54 28	6, 063, 076	215, 200	13 70	2, 948, 240
Mississippi	97, 200	51 37	4, 993, 164	100, 000	63 47	6, 347, 000	188, 800	13 47	2, 543, 136
Louisiana	79, 300	38 11	3, 022, 123	80, 700	58 82	4, 746, 774	110, 900	16 80	1, 863, 120
Texas	918, 000	22 40	20, 563, 200	180, 200	40 23	7, 249, 446	544, 500	14 53	7, 911, 585
Arkansas	180, 300	40 75	7, 347, 225	89, 300	51 59	4, 606, 987	187, 700	13 27	2, 490, 779
Tennessee	323, 700	44 00	14, 242, 800	99, 700	49 41	4, 926, 177	245, 700	15 82	3, 886, 974
West Virginia	122, 200	47 51	5, 805, 722	2, 400	49 96	119, 904	130, 500	23 48	3, 064, 140
Kentucky	386, 900	43 57	16, 857, 233	117, 800	44 05	5, 189, 090	257, 200	21 94	5, 642, 968
Ohio	772, 700	57 12	44, 136, 624	26, 700	59 44	1, 587, 048	714, 100	27 50	19, 637, 750
Michigan	333, 800	74 66	24, 921, 508	4, 300	87 23	375, 089	416, 900	26 88	11, 206, 272
Indiana	688, 800	48 47	33, 386, 136	61, 200	51 13	3, 129, 156	439, 200	23 60	10, 365, 120
Illinois	1, 100, 000	46 50	51, 150, 000	138, 000	53 13	7, 331, 940	702, 400	23 67	16, 625, 808
Wisconsin	384, 400	60 57	23, 283, 108	8, 700	76 29	663, 723	477, 300	20 88	9, 966, 024
Minnesota	247, 300	63 01	15, 582, 373	7, 000	79 02	553, 140	278, 900	19 10	5, 326, 990
Iowa	770, 700	50 92	39, 244, 044	43, 400	66 03	2, 865, 702	676, 200	21 14	14, 294, 868
Missouri	627, 300	39 89	25, 022, 997	191, 900	43 38	8, 324, 622	516, 200	17 80	9, 188, 360
Kansas	275, 000	49 93	13, 730, 750	50, 000	63 24	3, 162, 000	321, 900	21 82	7, 023, 858
Nebraska	157, 200	67 34	10, 585, 848	13, 600	87 45	1, 189, 320	127, 600	24 27	3, 096, 852
California	273, 000	43 95	11, 998, 350	25, 700	66 24	1, 702, 368	459, 600	25 90	11, 903, 640
Oregon	109, 700	50 05	5, 490, 485	3, 500	50 91	178, 185	112, 400	18 56	2, 086, 144
Nevada, Colorado, and the Territories	250, 000	50 00	12, 500, 000	25, 700	65 35	1, 679, 495	423, 600	22 62	9, 581, 632
Total	10, 938, 700	....	573, 254, 808	1, 713, 100	....	96, 033, 971	11, 826, 400	....	256, 953, 928
Grand average of prices	....	52 41	....	....	56 06	....	....	21 73	....

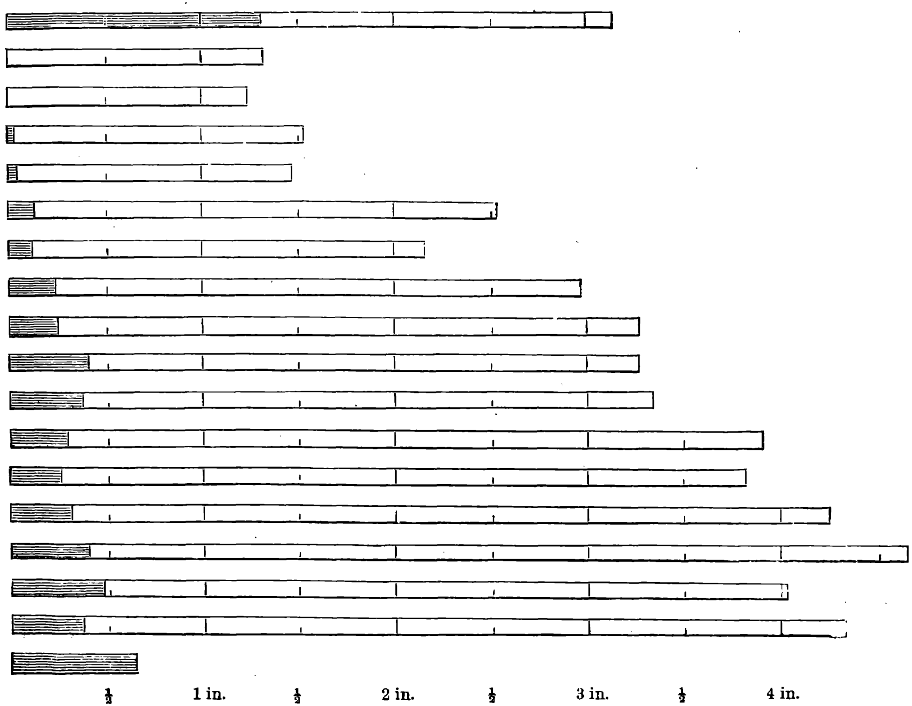
Table showing the estimated total number and total value of each kind of live stock, and the average price in January, 1879—**Continued.**

States.	OXEN AND OTHER CATTLE.			SHEEP.			HOGS.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	201, 700	$20 76	$4, 187, 292	557, 300	$2 69	$1, 499, 137	60, 300	$4 97	$299, 691
New Hampshire	125, 000	27 78	3, 472, 500	235, 100	2 28	536, 028	42, 900	8 93	383, 097
Vermont	127, 800	21 13	2, 700, 414	466, 000	3 58	1, 668, 280	50, 500	5 76	290, 880
Massachusetts	114, 900	51 29	5, 893, 221	60, 900	2 88	175, 392	84, 900	11 42	969, 558
Rhode Island	14, 300	26 45	378, 235	24, 500	3 47	85, 015	15, 400	9 20	141, 680
Connecticut	120, 800	29 27	3, 535, 816	96, 200	2 60	250, 120	61, 300	7 87	482, 431
New York	689, 300	27 18	18, 735, 174	2, 121, 000	3 29	6, 978, 090	975, 000	6 03	5, 879, 250
New Jersey	84, 500	28 78	2, 431, 910	127, 000	3 78	480, 060	152, 900	6 84	1, 045, 836
Pennsylvania	687, 000	23 58	16, 199, 460	1, 666, 000	2 99	4, 981, 340	927, 800	5 79	5, 371, 962
Delaware	32, 000	23 57	754, 240	37, 400	3 30	123, 420	47, 600	5 13	244, 188
Maryland	119, 200	19 26	2, 295, 792	152, 700	2 96	451, 992	262, 200	4 37	1, 145, 814
Virginia	431, 100	14 73	6, 350, 103	417, 800	2 21	923, 338	713, 600	2 76	1, 969, 536
North Carolina	415, 800	8 18	3, 401, 244	425, 000	1 28	544, 000	1, 262, 600	2 96	3, 737, 296
South Carolina	195, 700	9 66	1, 890, 462	182, 000	1 64	298, 480	508, 500	3 07	1, 561, 095
Georgia	404, 900	7 84	3, 174, 416	374, 400	1 53	572, 832	1, 620, 000	2 93	4, 746, 600
Florida	518, 900	7 42	3, 850, 238	59, 900	1 94	116, 206	197, 600	2 84	561, 184
Alabama	257, 500	8 53	2, 196, 475	204, 000	1 46	297, 840	1, 095, 100	2 38	2, 606, 338
Mississippi	247, 500	8 05	1, 992, 375	192, 600	1 55	298, 530	1, 386, 700	2 51	3, 480, 617
Louisiana	118, 700	7 81	927, 047	127, 500	1 82	232, 050	360, 500	3 41	1, 229, 305
Texas	4, 800, 000	9 15	43, 920, 000	4, 560, 000	1 80	8, 208, 000	1, 957, 000	2 91	5, 694, 870
Arkansas	357, 000	9 61	3, 430, 770	293, 500	1 49	437, 315	1, 123, 500	2 40	2, 696, 400
Tennessee	414, 000	9 28	3, 841, 920	858, 500	1 50	1, 287, 750	1, 900, 000	2 22	4, 218, 000
West Virginia	242, 400	19 75	4, 787, 400	571, 900	2 17	1, 241, 023	284, 300	2 79	793, 197
Kentucky	485, 000	17 31	8, 395, 350	1, 020, 000	2 02	2, 060, 400	1, 969, 500	2 23	4, 391, 985
Ohio	800, 000	21 19	16, 952, 000	4, 040, 000	2 42	9, 776, 800	2, 272, 500	3 36	7, 635, 600
Michigan	416, 000	20 47	8, 515, 520	1, 820, 000	2 30	4, 186, 000	567, 200	3 77	2, 138, 344
Indiana	780, 000	17 42	13, 587, 600	1, 039, 500	2 14	2, 224, 530	2, 325, 600	2 97	6, 907, 032
Illinois	1, 223, 100	18 91	23, 128, 821	1, 089, 000	2 12	2, 308, 680	3, 336, 000	3 31	11, 042, 160
Wisconsin	533, 500	16 70	8, 909, 450	1, 313, 000	1 97	2, 586, 610	635, 300	3 26	2, 071, 078
Minnesota	316, 100	17 28	5, 462, 208	307, 500	2 11	648, 825	196, 200	3 70	725, 940
Iowa	1, 356, 800	16 98	23, 038, 464	445, 500	2 02	899, 910	2, 915, 000	3 27	9, 532, 050
Missouri	1, 632, 000	14 94	24, 382, 080	1, 296, 400	1 59	2, 061, 276	2, 817, 600	2 21	6, 226, 896
Kansas	578, 300	17 45	10, 091, 335	312, 500	2 27	709, 375	1, 089, 000	3 03	3, 299, 670
Nebraska	369, 000	19 45	7, 177, 050	144, 000	2 30	331, 200	607, 600	3 03	1, 841, 028
California	1, 010, 000	18 91	19, 099, 100	6, 889, 000	1 61	11, 091, 290	565, 000	5 95	3, 361, 750
Oregon	188, 300	12 15	2, 287, 845	1, 160, 600	1 57	1, 822, 142	221, 900	3 19	707, 861
Nevada, Colorado, and the Territories	1, 000, 000	18 17	18, 170, 000	3, 435, 600	1 93	6, 630, 708	157, 500	7 51	1, 182, 825
Total	21, 408, 100	....	329, 543, 327	38, 123, 800	....	79, 023, 984	34, 766, 100	....	110, 613, 044
Grand average of prices	....	15 39	....	....	2 07	....	....	3 18	....

SUGAR.

Lined part of bars = Domestic Product. *Blank part of bars = Imports.*

Scale: 400 million lbs. to 1 inch.



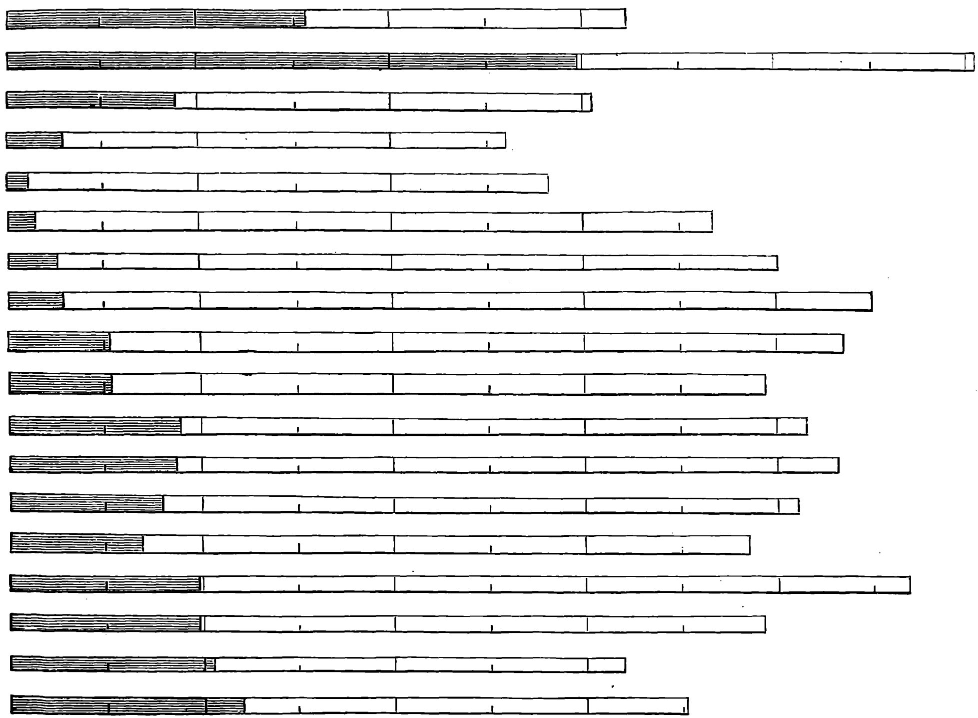
	Louisiana.	*Total.*
1861.	528, 321, 500 lbs.	1, 251, 620, 551 lbs.
1862.	....	530, 832, 412 "
1863.	....	498, 846, 665 "
1864.	7, 668, 200 "	611, 284, 438 "
1865.	17, 250, 000 "	594, 330, 143 "
1866.	47, 150, 000 "	1, 012, 799, 904 "
1867.	43, 294, 050 "	870, 526, 617 "
1868.	96, 894, 400 "	1, 195, 120, 413 "
1869.	100, 153, 500 "	1, 309, 847, 125 "
1870.	166, 613, 150 "	1, 306, 202, 065 "
1871.	147, 730, 150 "	1, 327, 450, 300 "
1872.	124, 798, 000 "	1, 565, 760, 616 "
1873.	102, 922, 700 "	1, 525, 974, 971 "
1874.	134, 504, 691 "	6, 705, 193, 954 "
1875.	163, 418, 070 "	1, 859, 159, 674 "
1876.	190, 672, 570 "	1, 604, 947, 134 "
1877.	147, 101, 941 "	1, 731, 573, 553 "
1878.	250, 094, 160 "	....

Relation of the domestic product to the total consumption of sugar in the United States.

MOLASSES.

Lined part of bars = Domestic Product. Blank part of bars = Imports.

Scale : 12½ *million galls. to* 1 *inch.*



	Domestic.	*Total.*
1861.	19, 808, 000 galls.	40, 191, 556 galls.
1862.	37, 018, 000 "	62, 668, 400 "
1863.	11, 000, 000 "	37, 569, 088 "
1864.	3, 828, 000 "	32, 410, 325 "
1865.	850, 000 "	35, 185, 038 "
1866.	1, 300, 000 "	45, 140, 110 "
1867.	3, 000, 000 "	49, 776, 435 "
1868.	3, 370, 000 "	55, 957, 969 "
1869.	6, 400, 000 "	54, 361, 092 "
1870.	6, 600, 000 "	49, 323, 171 "
1871.	10, 900, 000 "	52, 065, 784 "
1872.	10, 700, 000 "	53, 695, 203 "
1873.	9, 500, 000 "	51, 485, 526 "
1874.	8, 700, 000 "	48, 206, 257 "
1875.	12, 190, 000 "	58, 608, 734 "
1876.	12, 350, 000 "	48, 809, 504 "
1877.	12, 900, 000 "	39, 965, 906 "
1878.	15, 150, 000 "	43, 812, 509 "

Relation of the domestic products to the total consumption of molasses in the United States.

SUGAR.

In the diagram No. 1, preceding, is given the proportion of production to the consumption of sugar for this country during the last eighteen years. The long line denotes the total consumption of cane sugar in the United States; the shaded part of the line represents the amount produced in this country. In Diagram No. 2 the same applies to molasses.

In 1860, it will be observed, we raised nearly one-half the amount of sugar that we consumed, or, in round numbers, 500 million pounds, against a total consumption of 1,200 million pounds; whereas, in 1878, we only made 257 million pounds, against a total consumption of 1,731 million for the year ending June 30, 1878. This great decline is due to several causes: First. The effects of the war so changed the relations of labor that a corresponding change took place in the manner of carrying on the estates, and many were abandoned or neglected. It is an open question still whether capital will be invested in the same manner as in former times; many, and some of the most intelligent, planters believe that in time this great industry will be revived under a system of small farms and central factories, where the cane will be sold or ground on shares. This plan has the merit of allowing men of small means to combine and erect a sugar-house jointly, or will induce men other than planters to put their capital into a business that will be entirely separate trom the planting, and not subject to the same vicissitudes as when connected with the agricultural branch of the business of sugar-making. The great objection to this plan, viz, the transportation of the cane, which is very heavy, from divers farms, can and will be obviated by better roads, or by location in favorable bayous, so that transportation by boats can be made as cheaply as by carts now.

But another great drawback exists in the state of the levees to protect the lands from everflow. Formerly, when our production was nearly one-half our consumption, the State of Louisiana, which is the great center and real producer of our sugar crop, was tolerably well protected, but the wear and tear of war left the State in a sad condition both as regards levees and finances. It is useless to hope that private enterprise will accomplish a work of such magnitude. A private citizen can at great expense protect his river front or levee; but suppose his neighbor is unable to protect his equally well, the neglect of his neighbor, yes, neighbors for miles, will visit him with as great a loss as would have resulted from his own neglect. The sugar estates of Louisiana are generally located on the Mississippi River, beginning some sixty miles below New Orleans and going some two hundred miles above. There are also many estates in the parishes or counties to the westward of the river; in fact the greater portion of the State south of the Red River and west of the Mississippi is good sugar land. Yet of this immense area only 150,000 acres, or the area of one-half of a county, is planted in cane.

The yield per acre is from sixteen hundred pounds to three or four thousand of sugar, and a proportionate quantity of molasses. The crop of sugar is subject to no more, if as many, vicissitudes as the other staple crops of the country. No greater illustration of the value of the crop can be given than the single fact that the product of only 150,000 acres is so great as to be considered of national importance. It is only by such a comparison that we can realize the great possibility of our sugar lands when the subject shall receive the attention it deserves from the government.

In the State of Texas there are large bodies of land eminently suited to growing sugar-cane. In 1878 the crop was estimated at 6,000 hogsheads, with the prospect of a large increase. In Florida, also, there is an almost unlimited breadth of land suited by climate and soil to the culture of sugar.

The sugar product of the world is not increasing as fast as the demand. The amount consumed per capita is each year increasing; the amount consumed per capita in this country is larger than in any other, and is estimated at nearly 40 pounds. Besides this there is a large consumption of cane-molasses, sorghum, and maple sirup.

The crop of 1877 in Louisiana, "as reported by authorities," was only 127,000 hogsheads against 169,000 in 1876. This great decline resulted from severe cold weather in the month of November, which almost destroyed the cane for sugar-making purposes, but per consequence the product of molasses for 1877 shows a large increase over 1876. In 1878 the crop suffered no disaster and was the largest made since the war, being 250,094,000 pounds, or 208,571 hogsheads of sugar and 13,524,000 gallons of molasses.

HOPS.

According to the reports of our national census we produced, in 1860, malt liquors to the value of $7,994,707, with a working capital of $2,751,263; in 1870 the value of the product had increased to $55,706,643, or nearly sevenfold, and the capital to $48,779,435, or about eighteen-fold. The annual reports of the office of internal revenue since 1870, show a steady increase in the amount of malt liquors paying taxes. It is believed that a large amount of this production escapes taxation, and that the total product considerably exceeds 10,000,000 barrels per annum, or 360,000,000 gallons. The discrimination between "malt liquors" and "spirits" in our internal-revenue taxation has given to the former quite an impulse. While ale or beer pays but $1 per barrel, the more potent forms of alcoholic stimulant have been taxed as high as $2 per gallon. Brewing and its associated industries have assumed a special financial importance in later years.

One of these associated industries is the production of hops. The increase in both quality and value of this product has kept pace with that of the beverages for which this crop is specially grown. The crop of 1859, as reported in the census of 1860, aggregated only 10,991,996 against 25,456,669 pounds in 1869. Of the last-named amount New York produced 17,558,681 pounds, and Wisconsin 4,630,155 pounds, the two States yielding seven-eighths of the whole crop of the country. The State census of New York for 1875 reported for 1874 a crop of 13,846,065 pounds grown upon 28,278 acres. The acreage of the crop of 1875, then growing, was 37,004, which at only the low rate of the previous year would give over 18,000,000 pounds; that of 1877 probably exceeded 20,000,000 pounds.

For many years hop-raising has attracted special attention in Wisconsin. In 1876 the secretary of that State in his statistical report gave the acreage in hops of that year at 10,932 against 9,720 in 1875, and 8,051 in 1874. The acreage was considerably over 12,000 in 1877. The product of the year last mentioned was probably not less than 7,500,000 pounds, or about 600 pounds per acre. There is reason to believe that the national census report understates the product of Wisconsin. The commercial editor of the Chicago Times in 1867 investigated the hop industry of that State by personally visiting the hop districts and obtaining all the statistical facts there on record. He states the crop of Sauk

County alone, in that year, at 4,000,000 pounds, and estimates the crop of the whole State at 7,000,000 pounds. Two years afterwards, in 1869, the census-takers found only 1,250,269 pounds as the product of Sauk County, and 4,630,155 pounds for the whole State.

Hop-raising has also become an important interest in some other States. California, according to the census, in 1869 raised but 625,064 pounds. In 1876 the State surveyor-general reports an area of 1,573 acres, and a crop of 2,664,648 pounds. Michigan, in 1869, raised 828,269 pounds; the New England States nearly a million pounds. In nearly all the hop-producing sections of the Union the product and acreage have increased to a greater or less degree since 1869. Our total acreage approximates that of England, which is variously stated from 65,000 to 70,000. On the continent of Europe the total acreage is estimated at 76,000.

Our hop crop reached its maximum in 1877, in which year, according to commercial estimates, our surplus product amounted to 110,000 bales. Of this amount we sent to Europe 95,000 bales, leaving at the end of the year about 15,000 bales in the hands of producers and dealers. The disastrous season of 1878, however, will create a demand for this overplus.

The department instituted an inquiry in regard to the crop of 1878 by sending circulars to correspondents in the leading hop-producing counties of the Union. The result showed a reduced acreage for 1878, with the assured prospect of a still heavier reduction for 1879. The following extracts of correspondence will show the local aspects of this industry:

NEW YORK.—*Otsego:* New yards about equal to the old yards plowed up; average product, 500 pounds per acre; average price per pound, 10½ cents. Extension of yards held in check by fall of prices during two years past; acreage will be reduced this year. *Lewis:* Production decreasing on account of low prices; old yards running out and few new ones coming on. Acreage, 500, of which 50 were planted in 1878; average yield per acre, 800 pounds; average price, 9 cents. *Albany:* Not much life in the business; not a paying crop for several years. Acreage, 200; average yield, 400 pounds; average price, 10 cents. *Livingston:* On the decline; no new yards set out; acreage cultivated, 171; average yield, 900 pounds; average price, 7 cents. *Genesee:* No new yards; acreage, 150; average yield, 600 pounds; average price, 8 cents. The yield was light for the last two years, and the prices low; hence production is declining. We formerly had a home market, but not now; hops are sent East and sold on commission. *Saint Lawrence:* Acreage, 350; average yield, 800 pounds, some yards as high as 1,200 pounds per acre; average price, 7 to 8 cents; acreage about at a stand-still. *Schoharie:* On the decrease; acreage, 3,000; average yield, 800 pounds; average price, 8 cents. Prices during the last two years have not paid the cost of production. Acreage has been increasing till within the last two years.

Madison: Acreage probably decreased; average product from 700 to 800 pounds, in some yards 1,500 or 2,000; average price, 8 to 10 cents. The average cost of raising hops is from 12 to 14 cents per pound, according to the value of the land, and the cost of gathering and marketing from 8 to 10 cents per pound. *Wayne:* Production decreasing and but few yards left in the county. *Oswego:* Acreage 700, and decreasing; average product, 300 pounds; average price, 10½ cents. Crop uncertain and prices low, though at present showing some improvement. Choice brands bring from 12 to 15 cents for shipping.

WISCONSIN.—*Fond du Lac:* Production decreasing; total product of 1878, 12,453 pounds; average price 10 cents. *Calumet:* No hops raised; about six years ago nearly every one went out of the business; hops do not pay as well as other crops or even as pasturage. *Dane:* Production declining through low prices; acreage 189; average yield 720 pounds per acre; average price not over 7 or 8 cents per pound. *Sauk:* The crop an entire failure. I do not know a single yard that averaged a dozen pounds per acre, except one man in the western part who averaged 100 pounds. The failure of the crop was caused by the intense heat of July following a wet spell, and by the ravages of lice; average price, 25 cents. *Columbia:* Acreage, 250; about one-fourth what it was five years ago; average yield, 200 pounds, or only half the usual average; average price 6 to 8 cents against 50 cents formerly; damaged by lice; production greatly declining. *Dodge:* Acreage, 75, a decline of 40 per cent. from 1877;

average yield of acres picked about 80 pounds of inferior quality; the same yards in 1877 averaged 800 pounds; total product about 10,000 against 101,600 pounds in 1877. No sales of the crop of 1878 reported and very few of that of 1877. Prices offered by dealers only 5 or 6 cents per pound, or about one-third of the cost of production. The low prices induced many farmers to leave their yards unpicked, the price not being sufficient to pay for the picking. *Jefferson:* Decreasing; acreage 576, of which 25 were planted in 1878, but double that number were plowed up. The crop is no longer profitable in the county. *Richland:* The yards will be nearly plowed up in 1879; the crop of 1878 was a total failure; prices below cost of production; can hardly sell them for any price; not picked to any extent even where yards were cultivated. *Waukesha:* Acreage 176½; average yield, 620; average price, 10 cents; production declining. *Iowa:* Only one yard cultivated; destructive storms swept over the country; old yards allowed to run wild; the business considered a failure. An unknown worm did much injury to the vines. Hop-raising voted a failure here. *Waushara:* No new yards planted; average yield, 400 pounds; average price, 6 cents; crop badly winter-killed; production decreasing. *Juneau:* About 50 new acres planted; average yield not over 30 pounds; average price, 10 cents; production declining; crop nearly a failure, amounting to about 10 per cent. of an average. The business regarded as uncertain and ruinous, but the croppers hold on in hope of better times. *Vernon:* Acreage 114; crop a failure; price, 5 to 7 cents. The culture is decreasing, as it will no longer pay. The temperance movement is charged with narrowing the consumption of beer. The rush into this business was the result of a disposition to become suddenly rich. *Marquette:* No new yards planted; average yield, 300 pounds; average price, 6 cents; production decreasing; bad seasons and low prices. *Green Lake:* No hop-yards left; business unprofitable, and hence abandoned. *Trempealeau:* All the yards plowed up except two of about 32 acres; the lice ate the hops, and hence none were gathered.

The foregoing extracts show but a gloomy prospect for this interest in the future. The exports have fallen off at an enormous rate. During the ten months ending with April, 1879, the total export was 4,932,571 pounds against 17,290,750 pounds during the corresponding months of the previous fiscal year. One of our correspondents estimates the surplus of 1878 at 40,000 bales, which, added to the surplus of 1877, will make 55,000 bales. The prices obtained in nearly all the hop districts of the country were below the cost of production; hence the hop interest has suffered a terrible loss. The product of 1878 was generally of inferior quality.

A convention of hop-growers in New England, at a late session, appointed three different committees to estimate the average cost of producing hops. Committee No. 1 allowed $100 per acre for the average value of the land; cost of poles, fertilizers, and cartage, $44.10; labor in cultivation, $18; harvesting and curing, $64.36; insurance and marketing, $11.83; boxes, &c., $2.98; total, $141.27. A crop of 1,000 pounds would at such a rate average $14\frac{1}{8}$ cents per pound. Committee No. 2, allowing $80 per acre as the value of the land, estimated the average cost of 1,000 pounds at $12\frac{1}{4}$ cents. Committee No. 3, at $100 per acre, and with a yield of 800 pounds, made the average cost $12\frac{1}{5}$ cents per pound. The average cost of producing hops in Kent County, England, is estimated by a local authority at £5 or $24.30 per hundredweight (not quite 22 cents per pound).

As an illustration of the change in conditions of production the following statement of a hop-grower in Sauk County, Wisconsin, during the flush times of 1867, is given. His yard embraced 4 acres, and the capital invested, including land, poles, drying-house, stove, presses, &c., amounted to $2,000. During the second year of his investment, 1867, he estimated his expenses as follows: Interest on capital, 10 per cent., $200; cultivation, setting poles, &c., $100; harvesting, curing, &c., $943; total expenses, $1,243. Receipts, for 11,520 pounds of hops at 60 cents per pound, $6,912; net receipts for hop roots, $3,040; total receipts, $9,952; net receipts, $8,709, or 435 per cent.

Only an exceptional and precarious demand can produce such results as the above. That the demand was exceptional and merely speculative

is shown in its rapid and disastrous decline. The reports from the English hop districts are but little more encouraging. The Mark Lane Express publishes an estimate from its correspondent at the Canterbury hop-market to the effect that of the 70,000 acres under cultivation in England 10,000 acres would remain unpicked on account of failure. The remaining 60,000 acres are averaged at 8 hundredweight or 896 pound per acre, giving a prospective aggregate of 53,760,000 pounds. Prices, however, were very irregular. In most of the large districts the quantity raised was abundant, but the quality was far below average. The mass of the crop is of inferior quality. The better grades sold at $22.50 to $35 per hundredweight, or from 20 to 31 cents per pound. Common to poor hops at the close of the season commanded but a half or even a third of those rates. English hop-growers earnestly plead that if the crops of 1877 and 1878 had been of as good quality as in previous years, the hop interest would have held its own. But a number of adverse causes have reduced the character of the product. Heavy rains and high winds, together with mold, the result of excessive moisture, reduced both the quantity and the quality of the yields. But this is not all. A large amount of merely speculative culture has occupied the field. It is stated that intelligent growers well established in the business have succeeded in raising good crops, commanding prices which leave a fair margin of profit. Such men have been able to appreciate and provide against the adverse conditions, both natural and economic, which have burdened this interest during the last two years. Mere amateur and superficial enterprise, such as has been attracted to this crop by the profits made in former years, has not been able to resist the sweep of disaster. Such cultivators are clamoring for a protective tariff; but high commercial authority states that even with the advantage of free importation the stock of fine hops, both native and foreign, is far short of the demand.

FARM LABOR AND WAGES.

There have been made by this Department at divers times investigations on the subject of wages, first in 1866, then in 1875, and last in March, 1878, which was then omitted for the want of space, but is now incorporated, with the result of an investigation made in the spring of 1879.

During the first third of the present century there was little variation in the wages of farm labor. According to the estimates of Mr. H. C. Carey, the average per month was about $9 and board. The advance was slow until 1861, when the great disturbance of the labor supply and the difference in the circulating medium greatly enhanced the rate of wages for the few years following. The average wages of laborers boarding themselves was $28 per month; of all laborers, $26.

At the close of 1869 an investigation revealed the fact that a reaction had commenced, and that prices were beginning to recede. The average of $33 per month in New England had fallen to $32. The decline in the Middle States was from $30 to $29. In the Western States there was a larger decline, from $29 to $27; while the demand for labor in California had advanced the average there from $45 to $46. In the Southern States the rate of wages also increased slightly, and was about $16.80.

In 1875 another investigation was made, which showed a still further decline in the wages of agricultural labor. It was heaviest in the West and lightest in California; in the South and East it amounted to 10 per cent. With the increasing depression of the money market, many

factories and mills closed their doors, the hands were thrown either into idleness or competition with the other labor in the fields, and consequently wages fell with great rapidity.

Every investigation showed that those neighborhoods contiguous to manufacturing centers experienced the largest decrease: thus the artisans of Massachusetts, largely drawn from the New England States, returning to their former occupation, brought a heavy competition into their rural hills and corresponding decrease in wages. The decline in Maine was from $25.50 to $19 since 1875; New Hampshire, $28.50 to $21; Vermont, $29.67 to $21.30; exceeding 25 per cent. in each case. No other section showed so large a decrease. In 1866 Massachusetts paid the highest wages of any State east of the Rocky Mountains.

In the flourishing States of the West, as Kansas, Nebraska, and Minnesota, the decline since 1866 has been nearly the same as in the more eastern sections, with the difference that the decline was not so rapid.

The great demand for labor in those new and thriving States, the constant demand in the mining districts of the far West, and the market for produce created by those enterprises, was doubtless the cause of this easy and gradual decline. The record of Kansas reads:

Year.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.
1866	$38 94	$22 36	$41 61	$27 85
1869	35 95	22 16	41 00	27 75
1875	31 87	20 25	38 50	23 25
1878	25 00	14 00	30 00	18 33

In the Southern States east of the Mississippi River there was a gradual but moderate decline. With the fall in the price of cotton this was inevitable, but negro labor increased in efficiency and thus prevented a more rapid change. The following are the average rates paid for the year in the four periods as given above in three of the most populous States:

States.	1866.	1869.	1875.	1878.
North Carolina	$13 46	$12 76	$13 46	$12 00
Georgia	15 51	14 70	14 40	11 75
Mississippi	16 72	17 11	16 40	14 05

In the cotton States west of the Mississippi the price was well maintained. In Arkansas there was a great competition for labor in the years following the restoration of peace, and the prices paid were higher than in any other cotton State, averaging for those years and till 1875 about $25 a month, but in 1878 the price had fallen to $17.

In Texas, owing to the large proportion of white labor, and which was increased each year, the prices were more uniform than in any of the cotton States, and averaged till 1878 about $19.

In the central belt of agricultural States, represented by Pennsylvania, Ohio, Indiana, Illinois, and Iowa, a great uniformity was shown. In Pennsylvania board was somewhat higher in 1866 than in the other States, but in the wages paid, including board, the difference was nominal. This uniformity continued till the present monetary depression began, when, as a natural consequence, the competition of unemployed labor reduced the price in Pennsylvania below the more agricultural States.

It will be seen that the more western States of Illinois and Iowa maintained higher rates till 1878 than the Eastern States. The decline in the rate, which includes board in addition to money wages, since twelve years is as follows:

Year.	Pennsylvania.	Ohio.	Indiana.	Illinois.	Iowa.
1866	$18 84	$18 96	$18 72	$18 72	$18 87
1878	12 41	13 88	13 62	14 50	14 90

From returns made in April, 1879, and which include the latter part of 1878, the following table is prepared:

Average wages for 1879.

States.	PER MONTH.		PER DAY.								
	By the year.		Transient in harvest.		Transient not in harvest.		Carpentering.	Blacksmithing.	Wheelwrighting.	Machine making.	Shoemaking.
	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	Without board.	Without board.	Without board.	Without board.
Maine	$18 25	$11 08	$1 42	$1 09	$0 97	$0 72	$1 77	$1 70	$1 77	$2 07	$1 42
New Hampshire	19 75	12 30	1 25	96	98	74	1 85	1 83	1 93	1 92	1 35
Vermont	15 00	10 22	1 29	97	91	64	1 62	1 64	1 61	1 80	1 54
Massachusetts	25 00	15 33	1 50	1 00	1 05	75	2 00	1 94	1 87	2 40	1 75
Rhode Island	20 00	10 00	1 00	75	1 00	50	1 50	1 50	1 50	1 25	1 50
Connecticut	23 29	14 23	1 86	1 25	1 50	88	2 10	2 42	2 33	2 75	1 66
New York	20 61	13 19	1 53	1 18	92	68	1 72	1 67	1 92	2 00	1 53
New Jersey	20 22	11 53	1 55	1 30	99	68	1 77	1 86	1 72	2 00	1 57
Pennsylvania	19 92	11 46	1 33	99	96	63	1 54	1 49	1 54	1 77	1 31
Delaware	18 00	9 50	1 37	1 00	75	50	1 25	1 62	1 55	1 75	1 62
Maryland	13 50	8 95	1 43	1 12	75	48	1 87	1 70	1 70	2 05	1 62
Virginia	10 68	7 66	1 16	96	63	44	1 52	1 47	1 50	1 77	1 31
North Carolina	11 19	7 66	99	76	58	41	1 54	1 48	1 52	1 88	1 25
South Carolina	9 83	6 66	89	68	53	41	1 54	1 64	1 70	2 03	1 29
Georgia	10 73	7 38	98	61	58	44	1 45	1 70	1 78	2 27	1 45
Florida	13 80	8 73	1 02	73	76	53	2 13	2 18	2 10	2 62	1 70
Alabama	12 20	8 30	96	77	69	50	1 37	1 89	1 98	2 45	1 50
Mississippi	13 31	9 28	1 00	85	78	55	2 01	2 16	2 17	2 80	1 72
Louisiana	16 40	11 27	1 03	77	85	62	2 33	2 45	2 45	2 95	2 20
Texas	18 27	11 49	1 30	94	92	66	2 27	2 34	2 34	3 00	2 07
Arkansas	17 12	11 31	1 38	1 08	86	60	2 00	2 00	2 06	2 25	1 66
Tennessee	12 73	8 96	1 28	98	69	50	1 77	1 71	1 62	1 94	1 41
West Virginia	16 98	10 94	1 26	95	80	55	1 73	1 77	1 75	1 81	1 33
Kentucky	15 17	10 00	1 49	1 15	77	53	1 85	1 69	1 81	2 07	1 47
Ohio	20 72	13 34	1 51	1 17	1 00	83	1 77	1 76	1 85	1 98	1 51
Michigan	22 88	14 64	2 02	1 55	1 16	82	1 93	1 86	2 19	2 25	1 74
Indiana	19 20	12 76	1 68	1 28	90	69	1 67	1 68	1 78	1 76	1 52
Illinois	20 61	12 01	1 52	1 18	1 01	73	1 85	1 76	1 82	1 95	1 62
Wisconsin	21 07	13 81	2 11	1 70	1 12	79	1 94	1 83	1 95	2 25	1 55
Minnesota	24 55	15 62	2 63	2 25	1 27	94	2 16	2 13	2 21	2 39	1 81
Iowa	22 09	13 90	1 66	1 57	1 12	80	2 01	1 97	1 91	2 12	1 66
Missouri	17 59	11 84	1 47	1 17	67	59	1 81	1 78	1 79	2 06	1 66
Kansas	20 67	13 28	1 70	1 32	1 05	72	2 00	2 08	2 08	2 27	1 87
Nebraska	23 04	14 86	2 17	1 66	1 29	90	2 28	2 26	2 29	2 44	1 94
California	41 00	26 27	2 27	1 76	1 65	1 23	3 24	3 35	3 37	3 60	2 86
Oregon	35 45	23 86	2 02	1 54	1 44	1 08	3 12	3 06	3 27	3 28	2 72
Nevada	......	35 00	......	2 00	......	1 25	4 00	4 00	4 00	......	3 50
Colorado	35 00	20 00	2 08	1 55	1 83	1 19	3 10	2 75	2 00	2 50	2 50
Utah	28 87	20 50	1 82	1 43	1 46	1 12	2 72	2 82	2 86	3 20	2 23
New Mexico	22 10	13 80	1 00	67	81	56	2 40	2 80	3 00	4 37	3 50
Washington	35 83	24 34	2 15	1 61	1 55	1 11	3 21	3 29	3 30	3 50	2 67
Dakota	28 56	16 57	2 59	2 26	1 34	92	2 47	2 79	2 90	3 10	2 50

In the above table of labor for 1879 the first column, representing the wages per month without board of laborers hired by the year, may be

accepted as a very close approximation to the real prices of steady and permanent labor. Comparing the figures of this column with figures obtained from similar inquiries last year, we gain a clear idea of the movement of the agricultural labor market during the last twelve months. The average of the whole country has declined from $21.29 per month to $20.26, or 4.88 per cent. If we take the differences between the first and second columns in the above table, differences between wages with board and wages without board, we arrive at a very close estimate of the actual cost of subsisting the laborer in the different States. Taking the average of these differences for all the States, we find the average cost of this subsistence in 1879 to be $7.14 per month, against $7.45 in 1878, a decline of 4.16 per cent. The decline in wages is thus shown to be almost exactly in the same ratio as in the cost of subsistence.

Only four States and two Territories report an advance in wages; Minnesota and New Mexico about ½ per cent.; Colorado 15 per cent.; California 2¾ per cent.; Oregon 1¼ per cent.; and Washington 2½ per cent. All the other States show a decline.

The different sections of the Union, taken together, present some very interesting points of comparison. New England, as a whole, pays in 1879 $20.31 per month without board, on yearly engagements, against $22.60 in 1878, a decline of 10 per cent. But in this section it costs the laborer but $8.02 per month to live, against $9.13 the previous year, a decline of over 13 per cent. This indicates a relative improvement in the condition of labor, the cost of living having declined in greater proportion than wages. Massachusetts maintained her previous rate of wages, while reducing her cost of living over 12 per cent. Rhode Island reduced wages 18⅓ per cent., and cost of subsistence 7 per cent. Connecticut lowers wages less than 6 per cent., and subsistence over 15 per cent. As a general thing wages have declined in a smaller proportion than subsistence in manufacturing districts.

In the Middle States the average rate of annual wages fell from $21.19 per month to $19.69, or 7 per cent., while the average cost of subsistence declined from $8.51 per month to $8.27, or less than 3 per cent. New York reduced wages about 8¾ per cent. and cost of subsistence 10 per cent. On the other hand, New Jersey and Delaware increase their cost of subsistence each 2 per cent. while cutting down wages, the former nearly 6 per cent. and the latter 3¾ per cent.

The South Atlantic States pay an average wage of $11.19 against $13.11 last year, a decline of nearly 15 per cent. The cost of subsistence fell from $4.16 per month to $3.52, or over 16 per cent.; the greatest falling off is found in Maryland and Virginia, the former showing a decline in wages of nearly 23 per cent., and in cost of subsistence of 40 per cent., and the latter 18½ per cent. in wages, and 23 per cent. in living. North Carolina cuts down wages 6¾ per cent. and cost of board 8 per cent.; South Carolina 10⅗ per cent. and 7 per cent.; Georgia 8⅗ per cent. and 16 per cent. In these States the laborer gains slightly in the reduction of subsistence. Manufacturing and mining enterprises are on the advance. South Carolina is producing largely of phosphatic fertilizers and turpentine. Gold-bearing quartz is being extensively worked at several points in Georgia. Market-gardening and fruit-production for northern markets are enlarging the scope of skilled agricultural labor at various points along the coast. Few complaints of surplus labor are received from this section of the Union.

The Gulf States pay $14.80 per month against $15.52 in 1878, or less than 5 per cent. decrease. The cost of subsistence fell from $5.14 per month to $5.20, or a little over 3 per cent. Florida declined 8 per cent.

in wages and 5 per cent. in subsistence; Alabama 2½ per cent. in wages and 2½ per cent. in cost of subsistence; Mississippi over 9 per cent. in wages and 18 per cent. in subsistence; Louisiana over 3 per cent. in wages and 6 per cent. in subsistence. Texas, while lowering her average wages 1¼ per cent., has raised her cost of subsistence 17 per cent. The tone of correspondence shows, on the whole, a scarcity of labor rather than a surplus.

In the four inland Southern States the average rate of labor has declined from $16.25 per month to $15.50, or nearly 4½ per cent.; cost of subsistence from $5.47 per month to $5.20, or about 5 per cent. Labor generally finds fair remuneration, but many refuse to work at ruling rates of wages. Many complaints of shiftlessness and indolence on the part of the laboring population have been received.

The five States north of the Ohio River pay an average of $20.90 per month against $22.06 in 1878, a falling off of 5½ per cent.; the decline in subsistence has been very nearly at the same rate, or from $7.99 per month to $7.58. Ohio has fallen off 2½ per cent. in wages but maintains the same average cost of subsistence; Michigan fell off ½ per cent. in wages and 10½ per cent. in cost of subsistence; Indiana, 6½ per cent. in wages and 8 per cent. in cost of subsistence; Illinois, 11½ per cent. in wages and 1½ in cost of subsistence; Wisconsin 5 per cent. in wages and 4 per cent. in subsistence. State and county expenditure on public works is quite liberal. Reliable labor can in most cases find employment, but many localities are overrun with tramps. The tone of correspondence is very hopeful.

The six States west of the Mississippi pay on an average $23.81 per month against $23.77 in 1878, a slight increase. The average cost of support has fallen from $9.04 per month to 8.91, or less than 2 per cent. The increase of rate of wages is due mostly to the extension of mining enterprise in Colorado, which shows an increase of wages from $30 to $35, and an increase in subsistence of 17 per cent. Minnesota also shows a slight increase, from $24.42 to $24.55, or about ½ per cent., while her cost of subsistence has fallen off 3 per cent. Iowa pays nearly 6 per cent. less than last year, her average being $22.09 per month against $23.45; her cost of subsistence fell from $8.56 to $8.19, a decline of nearly 4 per cent. Missouri lowered her wages from $18.94 per month to $17.59, or over 7 per cent., and her subsistence from $6.20 to $5.75, or 7 per cent.; Kansas, $20.67 against $22.22, or a loss of nearly 7 per cent. in wages, and 7.39 against $8.25, or 11 per cent. loss in subsistence. Nebraska, wages fell from $23.60 to $23.04, or less than 2½ per cent; in subsistence, $9.60 to $8.18, or about 15½ per cent. In this region a large number of artisans have appropriated public lands and seek to pay for their claims by working part of the time at their trades. Quite a number of farm laborers have done the same, and work part of the time for other farmers. Thus, the vast immigration has enlarged the stock of labor, but it is, at least to a great extent, not very effective in character. Those desiring work can obtain it at fair wages. No surplus is noted in any county of Colorado. Railroad building, to a large extent, is noted in these States.

The two Pacific States report an average wage of labor of $38.22 against $36.62, an increase of 4⅓ per cent. Their cost of living has increased in much greater ratio, being $13.16 per month against $11.12, or 18 per cent. California raised her wages from $38.25 to $41, or less than 8 per cent., and her subsistence from $10.25 to $14.73, or 35 per cent.

In some quarters there are complaints of the competition of Chinese labor, while others state that white labor is twice as efficient as that of

the Mongol. In some counties the appearance of Chinese has caused white labor to be stampeded in a panic.

Oregon presents about the same general characteristics as California.

Nevada reports an average of $35 per month with board, which will amount to about $50 without board.

Of the Territories Utah reports an average of $28.87, a decline of 7 per cent. from 1878. There is a surplus of labor, attributed in part to general depression and in part to local causes.

New Mexico averages $22.10 against $22 in 1878. The common manual unskilled labor, being mostly Mexican, is a drug in the market. There is a demand for intelligent American labor, skilled and unskilled.

Washington Territory reports an average of $35.83 against $35 in 1878. In some counties, homesteaders and pre-emptors after settling on their claims find themselves somewhat impecunious, and they are then importunate for employment. Our Jefferson County correspondent says they have "too much brains and not enough muscle," which means an excess of people disposed to live without manual labor of any kind. Several railways in progress of construction. No surplus of labor; not sufficient in harvest.

Dakota reports $28.56 against $30 in 1878. One county reports a surplus of skilled labor on account of rapid immigration of artisans to public domain. Others state the supply of labor as deficient. One correspondent (Cass County) says they knew nothing of hard times. The national government is to expend some money in improving the rivers.

Our correspondent in Deer Lodge County, Montana, speaks of an unexpected and permanent improvement of times due to the permanency of agricultural and mining interests. Labor, here and in Lewis and Clarke County, finds ready employment.

In Arizona, Yavapai County finds labor supply and demand about equal.

No excess of labor reported in Wyoming. Stock raising immense.

OUR AGRICULTURAL EXPORTS.

Statement of the exports of agricultural products of the United States, with their immediate manufactures, for the two fiscal years ending June 30, 1878, *compiled from the Treasury report of commerce and navigation.*

Products.	1877.		1878.	
	Quantity.	Value.	Quantity.	Value.
Animals, living:				
Hogs ....number..	65,107	$699,180	29,284	$267,259
Horned cattle ....do....	50,001	1,593,080	80,040	3,896,813
Horses ....do....	2,042	301,134	4,104	798,728
Mules ....do....	3,441	478,434	3,860	501,513
Sheep ....do....	179,017	234,480	183,995	333,499
All other, and fowls ....do....	....	18,895	....	46,841
Animal matter:				
Bone-black, ivory-black, &c ....pounds..	584,134	28,711	2,738,784	80,740
Bones and bone-dust ....cwt..	70,720	121,493	47,429	78,989
Candles ....pounds..	1,616,163	234,408	1,567,265	218,985
Furs and fur-skins	....	3,836,579	....	2,618,100
Glue ....pounds..	157,246	30,679	250,563	31,247
Hair—				
Unmanufactured	....	338,487	....	361,348
Manufactures of	....	35,506	....	30,283
Hides and skins other than furs	....	3,113,883	....	1,286,840
Leather—				
Sorts not specified ....pounds..	25,122,936	6,016,273	28,389,140	6,189,052
Morocco and other fine	....	1,280,225	....	903,968
Boots and shoes ....pairs..	382,650	548,472	351,152	468,436

Statement of the exports of agricultural products of the United States, &c.—Continued.

Products.	1877.		1878.	
	Quantity.	Value.	Quantity.	Value.
Animal matter:				
Leather—				
Saddlery and harness		$94,085		$127,000
Other manufactures		742,300		391,574
Oil—				
Lard ... gallons	347,305	281,551	1,651,648	994,440
Other animal ... do	19,932	19,720	19,823	17,447
Provisions—				
Bacon and hams ... pounds	460,057,146	49,512,412	592,814,351	51,752,068
Beef, fresh ... do	49,210,990	4,552,523	54,046,771	5,009,856
salted ... do	39,155,153	2,950,952	38,831,379	2,973,234
Butter ... do	21,527,242	4,424,616	21,837,117	3,931,822
Cheese ... do	107,643,300	12,729,615	123,783,736	14,103,529
Condensed milk		123,801		128,284
Eggs ... dozen	37,606	9,733	94,265	14,880
Lard ... pounds	234,741,233	25,562,665	342,667,920	30,014,254
Mutton, fresh ... do	349,368	36,480	130,582	9,272
Pork ... do	69,671,894	6,296,414	71,889,255	4,913,657
Preserved meats		4,547,319		5,102,625
Soap—				
Perfumed and toilet		11,549		36,272
All other ... pounds	10,196,939	631,778	10,910,742	621,867
Tallow ... do	91,472,803	7,883,616	85,505,919	6,695,377
Wax ... do	307,091	93,521	326,613	95,074
Wool—				
Raw and fleece ... pounds	2,213,379	696,454	347,854	93,358
Carpets ... yards	23,479	16,377	10,626	10,430
Other manufactures		436,566		438,554
Total value of animals and animal matter		140,564,066		145,587,515
Breadstuffs and other preparations:				
Barley ... bushels	1,186,129	708,541	3,921,501	2,565,736
Bread and biscuits ... pounds	11,955,907	631,592	14,392,231	730,317
Corn ... bushels	70,860,983	41,621,245	85,461,098	48,030,358
Corn-meal ... barrels	447,907	1,511,152	432,753	1,336,187
Oats ... bushels	3,071,403	1,229,774	3,715,479	1,277,920
Rye ... do	2,189,322	1,822,766	4,207,912	3,051,739
Rye-flour ... barrels	7,989	41,633	6,962	30,775
Wheat ... bushels	40,431,624	47,256,417	72,404,961	96,872,016
Wheat-flour ... barrels	3,343,665	21,663,947	3,947,333	25,095,721
Other small grain and pulse		904,338		1,077,433
Other preparations of grain		650,206		1,709,639
Rice ... pounds	1,377,244	85,349	631,105	33,953
Total value of breadstuffs, &c		118,126,960		181,811,794
Cotton and its manufactures:				
Sea Island ... pounds	3,394,724	1,084,509	6,325,147	1,616,214
Other manufactures ... do	1,441,974,406	170,033,999	1,601,208,364	178,415,270
Colored goods ... yards	29,601,204	2,484,131	37,765,313	2,959,910
Uncolored ... do	76,769,147	6,437,223	88,528,192	7,053,463
All other manufactures		3,213,386		1,425,287
Total value of cotton, &c		183,253,248		191,470,144
Wood and its products:				
Boards, planks, joists, &c ... M feet	321,530	5,434,922	313,143	4,531,741
Laths, palings, pickets, &c ... M	4,992	16,800	3,050	9,233
Shingles ... M	38,327	126,632	46,518	154,533
Box-shooks		305,201		142,610
Other shooks, staves and headings		3,948,739		3,778,196
Hogsheads and barrels, empty ... number	136,724	255,911	82,402	159,420
All other lumber		846,410		520,454
Fire-wood ... cords	3,073	9,518	2,837	9,469
Hop, hoop, telegraph, and other poles		413,321		377,137
Logs, masts, spars, and other whole timber		499,822		352,104
Timber, sawn and hewn ... cubic feet	20,640,259	3,124,412	18,361,915	2,662,784
All other timber		60,059		114,907
Household furniture		1,700,412		1,961,522
Wooden ware		228,839		287,861
All other manufactures		1,373,039		1,714,440
Ashes, pot and pearl ... pounds	991,845	56,202	679,882	38,389
Bark for tanning		67,290		111,335
Resin and turpentine ... barrels	905,936	2,402,018	1,042,183	2,320,319
Spirits of turpentine ... gallons	6,843,029	2,293,009	7,633,568	2,333,569
Tar and pitch ... barrels	72,189	160,410	73,407	158,094
Total value of wood, &c		23,422,966		21,747,117

Statement of the exports of agricultural products of the United States, &c.—Continued.

Products.	1877.		1878.	
	Quantity.	Value.	Quantity.	Value.
Miscellaneous:				
Brooms, brushes, &c		$172,000		$146,037
Cordage, ropes, and twines of all kinds....lbs.	2,705,441	341,600	3,411,413	389,004
Fruits—				
Apples, dried....pounds..	14,318,052	920,292	4,188,173	260,085
green or ripe....bushels..	1,146,929	986,112	279,447	386,261
Other, green, ripe, or dried		494,427		296,310
Preserved in cans or otherwise		762,344		435,450
Ginseng....pounds..	440,406	562,268	421,395	497,247
Hay....tons..	7,457	120,293	9,514	141,340
Hemp—				
Unmanufactured....cwt..	1,467	12,182	2,325	18,210
Cables and cordage....do...	13,072	175,750	11,402	146,043
All other manufactures		719,809		1,056,709
Hops....pounds..	9,587,329	2,306,537	18,458,782	2,152,873
Liquors, alcoholic, cider and beer—				
Ale and porter—				
In bottles....dozens..	37,876	51,077	76,475	108,279
In casks....gallons..	155,277	42,488	119,579	38,918
Spirits distilled from—				
Grain....gallons..	1,008,741	489,174	2,258,401	864,162
Molasses....do...	647,331	285,979	655,864	272,457
Other materials....do...	4,224	10,174	12,386	12,653
Wine....do...	99,539	68,277	46,614	38,775
Oil-cake....pounds..	273,676,873	4,818,923	342,446,439	5,095,163
Oil—				
Cotton-seed....gallons..	1,705,422	842,248	4,992,349	2,514,323
Linseed....do...	59,495	43,435	38,901	27,232
Essential or volatile		448,057		323,341
Seeds—				
Cotton....pounds..	10,309,294	130,062	16,757,634	179,602
Flax or lint....bushels..	3	8	263	437
All other		3,438,450		2,085,887
Starch....pounds..	9,688,952	462,234	12,995,385	605,521
Sugar—				
Brown....pounds..	85,838	6,618	52,683	4,506
Refined....do...	54,315,349	6,198,139	44,040,409	4,508,148
Molasses....gallons..	3,157,923	849,877	1,477,057	365,753
Candy and confectionery		61,892		41,687
Tobacco—				
Leaf....pounds..	282,386,426	28,825,521	283,973,193	24,803,165
Cigars....M..	1,150	38,161	2,082	46,170
Snuff....pounds..	2,533	1,968	13,344	7,825
Other manufactures		3,213,393		3,627,322
Vegetables, &c.—				
Onions....bushels..	52,328	48,081	56,795	44,522
Pickles and sauces		48,523		19,667
Potatoes....bushels..	529,650	533,187	744,409	541,593
All others		116,518		138,509
Vinegar....gallons..	24,073	6,641	14,771	4,120
Total value of miscellaneous products		58,652,719		52,245,306

RECAPITULATION.

Products.	1871.	1872.	1873.	1874.
Animals and animal matter	$47,010,312	$77,060,849	$99,806,599	$99,697,660
Breadstuffs, &c	79,519,387	85,155,523	98,762,891	161,225,939
Cotton, &c	221,885,245	182,988,925	230,190,597	214,319,420
Wood, &c	15,820,029	21,425,068	25,854,120	27,675,300
Miscellaneous	33,060,081	40,139,296	37,901,458	45,486,626
Total agricultural exports	397,205,054	406,769,601	492,515,665	548,314,954
Total exports	562,518,651	549,219,718	649,132,563	693,039,066
Per cent. of agricultural matter	70	74	76	79

Statement of the exports of agricultural products of the United States, &c.—Continued.

RECAPITULATION.

Products.	1875.	1876.	1877.	1878.
Animals and animal matter	$104, 314, 988	$113, 941, 509	$140, 564, 066	$145, 587, 515
Breadstuffs, &c	111, 478, 096	131, 212, 471	118, 126, 940	181, 811, 794
Cotton, &c	194, 710, 507	200, 382, 240	183, 253, 248	191, 470, 144
Wood, &c	22, 875, 814	21, 620, 486	23, 422, 966	21, 747, 117
Miscellaneous	45, 294, 411	46, 079, 567	58, 652, 719	52, 245, 306
Total agricultural exports	478, 673, 816	513, 236, 273	524, 019, 939	592, 861, 876
Total exports	643, 094, 767	644, 956, 406	689, 167, 390	722, 811, 815
Per cent. of agricultural matter	74	79	76	84

The value of domestic exports for the year ending June 30, 1878, as will be seen in the table above, was greater than any previous year. The export for the year 1874 was the largest prior o this. In the years succeeding 1874 there was a large decline in agricultural products exported, which, however, has been more than regained in 1878. In the article of cotton the value was not so great in 1878 as in 1874, but the amount sent abroad was larger by half a million bales.

The proportion of agricultural products to the total export was 84 per cent. against 76 per cent. in 1877. Their actual increase in value was $68,841,937, a little more than 13 per cent., while the total export increased $33,644,425, a little less than 5 per cent.

The export of butter and cheese has, during the last few years, grown to a very large extent. The following table will show the increase since 1870. Fully three-fourths of the export is to Great Britain, the balance to British America and the West Indies:

Exports of dairy products.

Year ending June 30.	Butter.	Value.	Cheese.	Value.
	Pounds.		*Pounds.*	
1870	2, 019, 288	$592, 229	57, 296, 327	$8, 881, 934
1871	3, 965, 043	853, 096	63, 698, 867	8, 752, 990
1872	7, 746, 261	1, 498, 812	66, 204, 025	7, 752, 918
1873	4, 518, 844	952, 919	80, 366, 540	10, 498, 010
1874	4, 367, 983	1, 092, 381	90, 611, 077	11, 898, 995
1875	6, 360, 827	1, 506, 996	101, 010, 853	13, 659, 603
1876	4, 644, 894	1, 109, 496	97, 676, 264	12, 270, 083
1877	21, 527, 242	4, 424, 616	107, 364, 666	12, 700, 627
1878	21, 837, 117	3, 931, 822	123, 783, 736	14, 103, 529

The export of fresh beef, which only dates from a period of three years, is here given for those years:

Year ending June 30.	Quantity.	Value.
	Pounds.	
1876	19, 838, 895	$1, 743, 211
1877	49, 210, 990	4, 552, 523
1878	54, 046, 771	5, 009, 856

WHEAT PRODUCTION IN THE UNITED STATES.

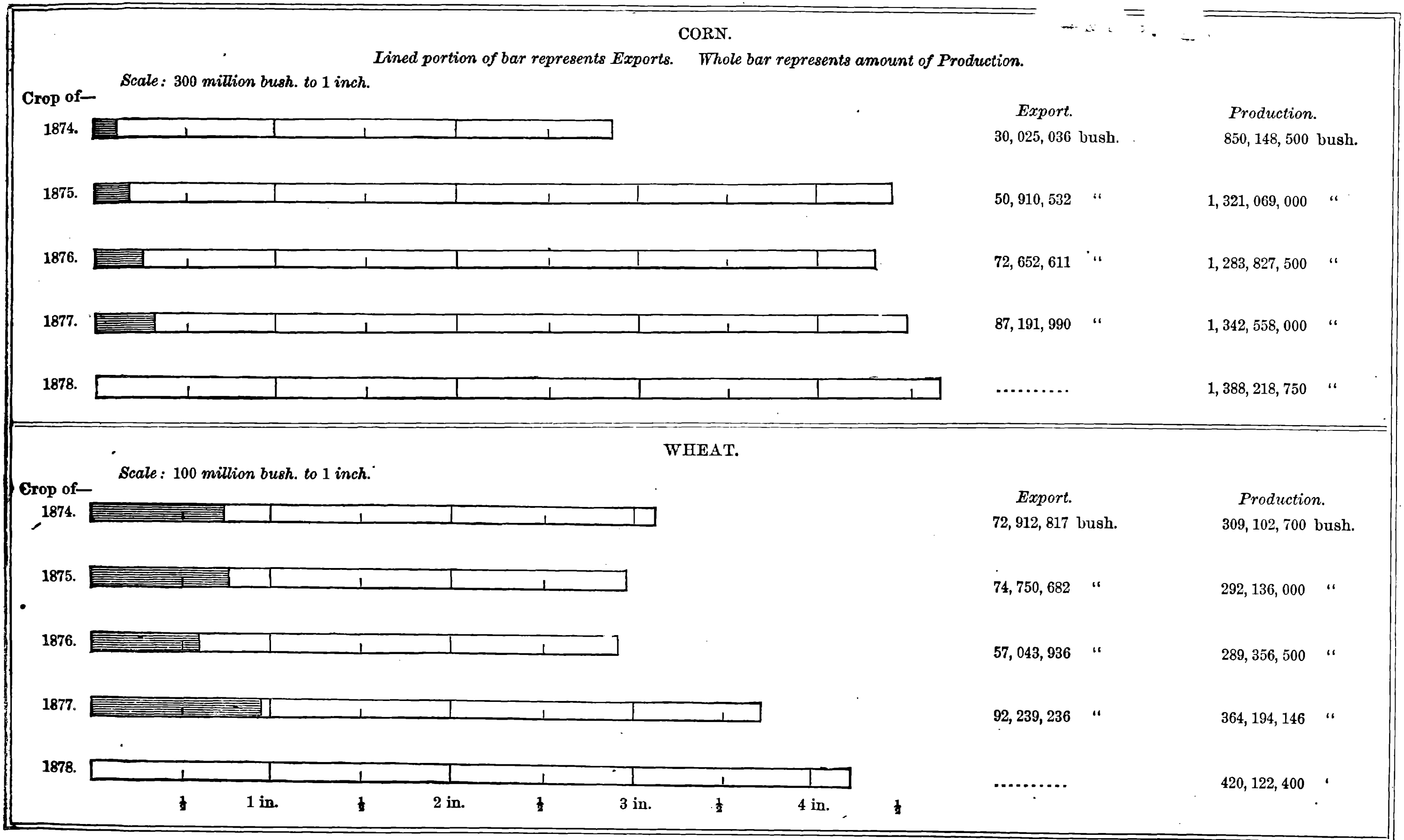
This Department, since its organization in 1862, has published sixteen annual estimates of the wheat crops, an abstract of which will be found in the table below. It should be remembered that the earlier years of this period were years of civil war, in which a portion of our wheat area was the scene of hostile operations destructive of settled industry—hence our figures for those years were abnormally low. From 1866 however, the first year after the close of the war, there was a steady enlargement of our wheat acreage, more than doubling in 1878 the aggregate of 1866. Dividing the sixteen years under consideration into two equal periods we find the average acreage of the second eight years to be 50 per cent. greater than in the eight years preceding. The wheat acreage of 1878 is about equal to the area of the State of Alabama.

The average yield per acre ranged from 10 bushels per acre in 1866 to 13.9 bushels in 1877, averaging 12.2 bushels per acre during the whole period. It is remarkable that the average of the two subordinate periods of eight years is precisely the same. This fact shows that the productiveness of our wheat area has on the whole been maintained. As our acreage has enlarged in a greater proportion than our population our production per capita has increased. Comparing our estimates of products with Elliott's estimates of population, we find that the average yield per capita during the first eight years, was less than 5¾ bushels against nearly 7 bushels in the second eight years. The enormous crop of 1878 averaged about 8¾ bushels.

It is evident that the consumption of wheat has increased among our own people, but not to anything like the extent necessary to absorb our late enormous crops. To account for this we must look to the immense demand for breadstuffs that has lately grown up in Western Europe. This demand is the result of restricted production. Not only unfavorable growing conditions have restricted the productiveness of the wheat crop during the last few years, but also a change in the economic conditions of this industry. The area devoted to wheat in the United Kingdom has been gradually decreasing for several years on account of the growing cost of culture and the increasing competition of other countries, especially the United States. In 1858 the British Islands imported 23,201,941 cwt. of wheat and flour reduced to its equivalent in grain; fifteen years later the import had doubled, amounting in 1872 to 47,612,896 cwt.; the average annual import of this period was 37,876,191 cwt. Of this average the United States contributed 27 per cent., Russia 24, Germany 17, France 9, British America 7.

During the following six years ending with 1878 the average import rose to 57,665,777 cwt., including flour and meal. Of this import the United States furnished 48 per cent. of the wheat and 36 per cent. of the flour; Russia less than 19 per cent. of the grain and a proportion of flour too small for notice; Germany, 8 per cent. of the wheat and 14 per cent. of the flour; France, 1⅔ per cent of the wheat and less than 20 per cent. of the flour; British North America, nearly 7 per cent. of the wheat and over 5 per cent. of the flour. It should be noted, however, that in the last year or two, wheat imports from France have nearly ceased and flour imports have fallen to about a third of the average of the period. British India sent a large contribution in 1877, but during the last year it fell off greatly. The supplies from Australia have been very irregular, while Turkey and Egypt, once sending large supplies, have greatly declined.

The reports from the United Kingdom, as well as the United States,



Relation of export to production.

show that we are rapidly gaining the control of this trade, and that other countries in Western Europe are not only retiring from competition with us, but also that they are opening markets for the increased disposal of our breadstuffs. A social revolution is indicated by these facts. Production and consumption are regulated by conditions greatly different from what they were six years ago. The rapid enlargement of our wheat area was necessary to meet the marked decline in European production. The proportion of our crop exported is rapidly growing. Of the crop of 1877 over one-fourth was required to meet the foreign demand. From the rate at which we are now exporting breadstuffs it would not be surprising to find at least 35 per cent. of our vast product of 1878 taken by this export trade.

The prices realized by the farmer have fluctuated for the last few years, but in 1878 they settled to a lower point than in any previous year. Hence, though the product of 1878 exceeded its predecessor by about 56,000,000 bushels, its aggregate value fell off over $68,000,000. This, however, being the result of a general decline of values to a specie basis, does not indicate a loss to the farmers at all in proportion to the figures. The price per bushel $0.77.7 in January, 1879, and the average value of the crop per acre, $10.16, are unprecedentedly low, but there is nothing to indicate that wheat products have declined in greater proportion than manufacturing products. The cheapness of this class of agricultural products is the result of their abundance, and this enables us to transport our grain across the ocean and undersell the wheat farmers of the high-priced lands of Europe.

Years.	Acreage.	Yield per acre.	Total product.	Price per bushel.	Total value of product.	Total value per acre.	Wheat and flour exported in the fiscal year closing June 30, following.	Proportion of exports to the crop of the calendar year.
		Bush.	*Bushels.*				*Bushels.*	*P. ct.*
1863	13, 098, 936	13. 2	173, 677, 928	$1. 40. 0	$197, 992, 837	$15 12	41, 468, 447	23. 9
1864	13, 158, 089	12. 2	160, 695, 823	1. 83. 2	294, 315, 119	22 37	22, 959, 862	14. 3
1865	12, 304, 894	12. 1	148, 552, 829	1. 46. 3	217, 33 , 195	17 66	16, 494, 353	11. 1
1866	15, 424, 496	10	151, 999, 906	2. 06. 4	333, 773, 646	21 64	12, 646, 941	8. 3
1867	18, 321, 561	11. 5	212, 441, 400	1. 98. 5	421, 796, 460	23 02	26, 323, 014	12. 4
1868	18, 460, 132	12. 1	224, 036, 600	1. 42. 5	319, 195 290	17 29	29, 717, 201	13. 2
1869	19, 181, 004	13. 5	260, 146, 900	0. 94. 1	244, 924, 120	12 76	53, 900, 780	20. 7
1870	18, 992, 591	12. 4	235, 884, 700	1. 04. 2	245, 865, 045	12 94	52, 574, 111	22. 3
1871	19, 943, 893	11. 5	230, 722, 400	1. 25. 8	290, 411, 820	14 56	38, 995, 755	16. 9
1872	20, 858, 359	11. 9	249, 997, 100	1. 24	310, 180, 375	14 87	52, 014, 715	20. 8
1873	22, 171, 676	12. 7	281, 254, 700	1. 15	323, 594, 805	14 59	91, 510, 398	32. 6
1874	24, 967, 027	12. 3	309, 102, 700	0. 94. 1	291, 107, 895	11 66	72, 912, 817	23. 5
1875	26, 381, 512	11	292, 136, 000	1. 00	294, 580, 990	11 16	74, 750, 682	25. 6
1876	27, 627, 021	10. 4	289, 356, 500	1. 03. 7	300, 259, 300	10 86	57, 149, 949	19. 7
1877	26, 277, 546	13. 9	364, 194, 146	1. 08. 2	394, 695, 779	15 08	92, 141, 626	25. 3
1878	32, 108, 560	13. 1	420, 122, 400	77. 7	326, 346, 424	10 16	....	......
Average of whole	20, 579, 831	12. 2	250, 270, 127	1. 20. 3	300, 398, 131	14 60	....	......
Average 1863–'70	16, 117, 713	12. 2	195, 929, 511	1. 45. 1	284, 399, 089	17 64	....	......
Average 1871–'78	25, 041, 949	12. 2	304, 610, 743	1. 03. 9	316, 397, 173	12 63	....	......

CORN PRODUCTION IN THE UNITED STATES.

The table given below embraces the results of sixteen annual investigations of the corn crops, and shows our remarkable progress in this branch of production. As in the case of wheat, the first three years included in the table were years of civil war, and a large portion of our corn area was involved in its disasters. Hence the aggregates for those

years are abnormally low. The acreage of 1865 was nearly doubled in 1866 and nearly tripled in 1878. During the year last named our corn-fields were nearly equal in area to the State of Kansas.

The average product per acre was substantially the same throughout, amounting to 26.6 bushels during the latter eight years, against 26.8 bushels in the previous eight years. Our four last crops each exceeded considerably a billion and a quarter of bushels. As in the case of wheat, the supplies have grown faster than the population. During the first eight years the out-turn averaged 21.40 bushels per capita, and during the latter eight years, 24.07 bushels; in 1875, it amounted to nearly 30 bushels. Our surplus in later years has found an increasing foreign out-let. During the first eight years we sent abroad but 1.20 per cent. of our product; during the latter eight years, 4.37 per cent.; of the crop of 1877, we shipped abroad 6½ per cent., and the crop of 1878 is going out probably in about the same proportion.

The average price obtained by the farmer has fallen off two-thirds in fifteen years, being 99.7 cents per bushel in 1864, and 31.8 cents in 1878. The last-named crop, though greater by 46,000,000 bushels than its predecessor, fell short of it $39,000,000 in aggregate value. The average value of each acre's yield has fallen to the unprecedented low figure of $8.55 in 1878; in 1864 it amounted to $30.64. The last-named year, however, was one of extreme moneyed inflation. Corn has fallen off proportionally more than wheat. Its abundance and cheapness has made it the object of a very considerable and growing export trade.

Years.	Acreage.	Yield per acre.	Total product.	Price per bushel.	Total value of product.	Total value per acre.	Corn and corn-meal exported in the fiscal year closing June 30, following.	Proportion of crops exported.
		Bush.	*Bushels.*				*Bushels.*	*P. ct.*
1863	15, 312, 441	25. 98	397, 839, 212	$0. 69. 9	$278, 089, 609	$18 16	5, 146, 192	1. 29
1864	17, 438, 752	30. 42	530, 451, 403	99. 5	527, 718, 183	30 26	3, 610, 402	. 68
1865	18, 990, 180	37. 09	704, 427, 853	46. 0	324, 168, 698	17 07	14, 465, 751	2. 05
1866	34, 306, 538	25. 30	867, 946, 295	68. 2	591, 666, 295	17 21	16, 026, 947	1. 85
1867	32, 520, 249	23. 63	768, 320, 000	79. 5	610, 948, 390	18 49	12, 493, 522	1. 62
1868	34, 887, 246	25. 9	906, 527, 000	62. 8	569, 512, 460	16 32	8, 286, 665	. 91
1869	37, 103, 245	23. 5	874, 320, 000	75. 3	658, 532, 700	17 74	2, 140, 487	. 24
1870	38, 646, 977	28. 3	1, 094, 255, 000	54. 9	601, 839, 030	15 57	10, 676, 873	. 98
1871	34, 091, 137	29. 1	991, 898, 000	48. 2	478, 275, 900	14 02	35, 727, 010	3. 60
1872	35, 526, 836	30. 7	1, 092, 719, 000	39. 8	435, 149, 290	12 24	40, 154, 274	3. 68
1873	39, 197, 148	23. 8	932, 274, 000	48. 0	447, 183, 020	11 41	35, 985, 834	3. 86
1874	41, 036, 918	20. 7	850, 148, 500	64. 7	550, 043, 080	13 40	30, 025, 036	3. 53
1875	44, 841, 371	29. 4	1, 321, 069, 000	42. 0	555, 445, 930	12 38	50, 910, 532	3. 85
1876	49, 033, 364	26. 1	1, 283, 827, 000	37. 0	475, 491, 210	9 69	72, 652, 611	5. 66
1877	50, 369, 113	26. 6	1, 342, 558, 000	35. 8	480, 643, 400	9 54	87, 192, 110	6. 50
1878	51, 585, 000	26. 9	1, 388, 218, 750	31. 8	441, 153, 405	8 55	....	......
Average of whole period	35, 930, 407	26. 7	959, 174, 938	52. 3	501, 616, 287	13 96	....	......
Average 1863–'70	28, 650, 703	26. 8	768, 010, 845	67. 7	520, 309, 421	18 16	....	......
Average 1871–'78	43, 210, 111	26. 6	1, 150, 341, 531	42. 0	482, 923, 154	11 18	....	......

DISTRIBUTION OF OUR AGRICULTURAL EXPORTS.

ANIMALS AND ANIMAL MATTER.—The export of live animals shows an extraordinary increase—76 per cent. in total value—over last year. This is owing to the vast expansion of the horse and cattle trades during 1878, and to a large increase in the export of mules and sheep. Hogs fell off about three-fifths. The United Kingdom about quintupled its previous demand upon us for live stock. Continental Europe, which had

previously taken a very small proportion of this export, during the last year absorbed nearly a quarter million of dollars' worth. On the other hand, Mexico, Central and South America, and the West Indies, fell off in the aggregate value of their demand, but a portion of this reduction is due to a decline of prices. The distribution of farm animals is shown by the following table:

Animals.		United Kingdom.	Continental Europe.	British North America.	Mexico.	Central and South America.	West Indies.	Japan.	Other countries.	Total exports.
Cattle	number	24, 982	2, 349	9, 843	964	49	41, 797	29	27	80, 040
	value	$2, 408, 843	$206, 898	$452, 547	$8, 196	$2, 887	$809, 097	$5, 045	$3, 305	$3, 896, 818
Hogs	number	7, 867	515	20, 655	260	8	572	3	4	29, 284
	value	$69, 395	$2, 935	$190, 414	$1, 103	$200	$3, 087	$85	$40	$267, 259
Horses	number	2, 570	40	452	295	183	518	11	35	4, 104
	value	$579, 765	$7, 500	$73, 670	$5, 583	$29, 778	$88, 147	$4, 060	$10, 220	$798, 723
Mules	number	57	....	12	7	320	3, 464	......	......	3, 860
	value	$6, 400	....	$1, 240	$240	$41, 038	$452, 595	......	......	$501, 513
Sheep	number	15, 038	655	10, 024	153, 065	1, 825	2, 231	......	1, 157	183, 995
	value	$109, 777	$4, 980	$22, 654	$158, 217	$10, 961	$20, 334	......	$7, 080	$334, 003
All other and fowls, value		$1, 150	$1, 084	$7, 129	$22, 982	$2, 501	$9, 070	......	$2, 925	$46, 841
Aggregate values		$3, 175, 330	$223, 397	$747, 654	$196, 321	$87, 365	$1, 382, 330	$9, 190	$23, 570	$5, 845, 157

Of our exports of dead animal matter pork products constitute over 60 per cent. The following table shows their distribution:

Articles.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	Other European countries.
Bacon and hams	pounds	413, 467, 543	55, 280, 429	28, 022, 987	58, 281, 937	12, 170, 639
	value	$38, 241, 651	$4, 161, 468	$2, 201, 208	$4, 423, 329	$758, 372
Lard	pounds	114, 484, 711	50, 465, 990	85, 352, 594	35, 364, 915	3, 740, 539
	value	$10, 175, 475	$4, 274, 074	$7, 413, 937	$3, 076, 173	$311, 912
Pork	pounds	22, 130, 653	599, 969	702, 900	169, 520	98, 400
	value	$1, 709, 123	$42, 523	$49, 961	$11, 587	$10, 076
Lard-oil	gallons	1, 189, 127	165, 592	80, 993	39, 652	....
	value	$741, 158	$108, 871	$13, 599	$25, 221	....
Aggregate values		$50, 867, 407	$8, 586, 936	$9, 678, 705	$7, 536, 310	$1, 080, 360

Articles.		British America.	West Indies.	Mexico and South and Central America.	Other countries.	Total export.
Bacon and hams	pounds	5, 697, 324	13, 611, 916	948, 827	332, 749	592, 314, 351
	value	$575, 568	$1, 241, 763	$104, 026	$44, 683	$51, 752, 068
Lard	pounds	3, 045, 168	29, 994, 189	19, 413, 449	806, 365	342, 667, 920
	value	$261, 639	$2, 505, 505	$1, 918, 598	$76, 941	$30, 014, 254
Pork	pounds	16, 425, 574	26, 852, 111	3, 782, 363	1, 127, 765	71, 889, 255
	value	$1, 011, 558	$1, 751, 603	$251, 351	$75, 875	$4, 913, 657
Lard-oil	gallons	51, 043	15, 625	90, 731	18, 883	1, 651, 648
	value	$35, 384	$10, 562	$43, 396	$16, 249	$994, 440
Aggregate values		$1, 884, 149	$5, 509, 433	$2, 317, 371	$213, 748	$87, 674, 419

Compared with 1877 the above table shows a total increase in the aggregate values of 8 per cent. in spite of a marked decline in prices. All the items show a greater increase in quantities than in values. The United Kingdom, with a large increase in quantities, especially in lard-oil, shows a moderate increase in total value of exports. France has nearly doubled her demand for this class of products, while Germany and other continental countries give us a widening market. On the other hand, the West Indies with North and South America show declining values with no great changes in quantity. It is evident that our exuberant and cheap pork production is giving us the control of the civilized markets of Europe, and that we may expect a greatly enlarged trade in this class of staples in years to come.

Beef-products fall off from last year in aggregate value over $2,000,000. Several articles, however, show a marked increase in the quantity shipped, especially fresh beef and cheese. The following table shows where this class of products went during 1878:

Articles.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	Other European countries.
Fresh beef	pounds	53, 546, 469	487, 690			
	value	$4, 966, 152	$42, 537			
Salt beef	pounds	26, 770, 011	295, 446	2, 018, 009	875, 031	293, 940
	value	$2, 118, 992	$20, 693	$151, 518	$65, 322	$20, 144
Butter	pounds	14, 345, 758	27, 268	2, 854, 128	97, 350	5, 897
	value	$2, 650, 570	$3, 188	$434, 596	$19, 852	$758
Cheese	pounds	120, 929, 600	3, 400	47, 476	4, 872	497
	value	$13, 759, 385	$364	$5, 986	$492	$86
Condensed milk	value	$34, 135		$132		
Tallow	pounds	41, 000, 530	18, 790, 904	3, 720, 206	10, 930, 336	7, 239, 686
	value	$3, 172, 989	$1, 503, 502	$281, 468	$850, 987	$574, 368
Glue	pounds	51, 953	400	24, 890	2, 469	
	value	$6, 402	$80	$4, 166	$6, 400	
Hides	value	$272, 579	$232, 120	$280, 937	$57, 909	$7, 150
Neat's-foot oil	gallons	18, 402				
	value	$16, 067				
Candles	pounds	6, 289		220	100	288
	value	$1, 027		$55	$36	$91
Leather	pounds	18, 331, 612	15, 014	7, 179, 537	1, 341, 039	145, 600
	value	$3, 791, 404	$2, 471	$1, 638, 723	$382, 264	$30, 963
Morocco	value	$795, 155		$4, 581	$59, 945	
Manufactures of leather	value	$152, 533	$3, 849	$105, 681	$49, 761	$2, 004
Aggregate value		$31, 737, 390	$1, 808, 804	$2, 907, 843	$1, 492, 468	$635, 564

Articles.		British America.	West Indies.	Mexico, Central and South America.	Other countries.	Total export.
Fresh beef	pounds	1, 209	11, 403			54, 046, 771
	value	$125	$1, 042			$5, 009, 856
Salt beef	pounds	1, 632, 539	4, 757, 107	1, 241, 993	947, 515	38, 831, 379
	value	$102, 106	$343, 945	$97, 425	$53, 089	$2, 973, 234
Butter	pounds	1, 158, 924	2, 471, 113	563, 791	312, 888	21, 837, 117
	value	$208, 756	$413, 601	$126, 202	$74, 299	$3, 931, 822
Cheese	pounds	1, 651, 726	716, 736	307, 864	121, 565	123, 783, 736
	value	$180, 368	$94, 004	$40, 120	$22, 724	$14, 103, 529
Condensed milk	value	$3, 488	$18, 180	$9, 957	*$62, 392	$128, 284
Tallow	pounds	886, 974	417, 729	2, 484, 962	34, 592	85, 505, 919
	value	$59, 579	$35, 156	$216, 292	$1, 036	$6, 695, 377

Articles.		British America.	West Indies.	Mexico, Central and South America.	Other countries.	Total exports.
Glue	pounds	50,697	14,430	9,499	16,225	250,563
	value	$7,997	$2,534	$1,524	$2,144	$31,247
Hides	value	$390,347	$338	$1,766	$43,694	$1,286,840
Neat's-foot oil	gallons	145	28	356	892	19,823
	value	$143	$32	$285	$920	$17,447
Candles	pounds	74,744	728,587	725,757	31,280	1,567,265
	value	$9,612	$100,994	$102,150	$5,020	$218,985
Leather	pounds	436,189	329,410	49,256	561,483	28,389,140
	value	$107,050	$69,824	$15,409	$150,944	$6,189,052
Morocco	value	$5,260	$5,419	$8,123	$25,485	$903,968
Manufactures of leather	value	$186,658	$151,440	$191,358	$144,226	$987,010
Aggregate value		$1,261,489	$1,236,509	$810,611	$585,973	$42,476,651

*Among the largest exports of condensed milk were $21,790 to Australia, $21,252 to Japan, $8,897 to China.

This class of products constitutes over 30 per cent. of our last annual export of animal matter. Compared with the previous year, the United Kingdom takes a smaller aggregate value, but most of the products shipped to that country show increased quantities. For instance, fresh beef shows an enlargement of over 4,000,000 pounds; salt beef, 1,000,000; cheese, 16,000,000; leather, 3,000,000, &c. On the other hand, tallow fell off 21,000,000 pounds. With continental Europe our trade in these staples has increased to a considerable extent in values and still more in quantity. With the West Indies, North and South America, our shipments of this class of products have very considerably declined.

Of sheep-products we sent out, during the year, only 130,582 pounds of fresh mutton, valued at $9,272, against 349,368 pounds, valued at $36,480 in 1877. The United Kingdom took all of this class of exports. Of wool we shipped 347,854 pounds, valued at $93,358, against 2,213,379 pounds, valued at $696,454 in 1877; of wool manufactures $448,894, against $452,943 in 1877.

BREADSTUFFS.—Our export of breadstuffs shows an enormous increase, the aggregate value reaching $181,811,794, against $118,126,960 in 1877. All the articles of this class show an increased movement, except corn-meal, rye-flour, and rice, which bear an insignificant proportion to the whole. Our barley exports more than tripled in quantity; corn increased 20,000,000 bushels; oats more than doubled in quantity; rye rose from 118,029 to 4,207,912; wheat from 40,431,624 bushels to 72,404,961, and from $47,256,417 to $96,872,016. Flour, with an increased shipment of less than 16,000 barrels, increased its aggregate value $3,331,774. The smaller grains and all preparations of grain for food were marketed in enlarged quantities and values.

The United Kingdom takes $125,819,463, against $76,129,976 in 1877. France raises her requirement from $2,050,121 to $7,657,563; Belgium and Netherlands from $3,185,730 to $9,362,071; other European countries also greatly increase their demand except Germany, which fell from $3,263,603 to $1,764,517. The countries of North and South America and West Indies have slightly increased their demand. The export price of wheat is very considerably increased, being $1.33 per bushel, against $1.14, but corn has fallen from 58 cents to 56 cents; flour also declined from $6.48 to $6.25 per barrel. Barley, oats, and rye were

shipped in greatly increased quantities. The following table shows our movement of breadstuffs:

Products.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	Other European countries.
Barley	bushels	3, 421, 308	....	14, 150	137, 302	1, 410
	value	$2, 300, 675	....	$8, 380	$92, 897	$780
Bread, &c	pounds	3, 264	....	9, 984	4, 800	200
	value	$314	....	$376	$260	$42
Corn	bushels	65, 915, 851	2, 872, 784	1, 968, 879	1, 359, 582	3, 639, 929
	value	$37, 749, 226	$1, 552, 109	$1, 082, 109	$748, 949	$2, 054, 297
Corn-meal	barrels	7, 088	....	994	10	4
	value	$21, 547	....	$2, 800	$48	$13
Oats	bushels	109, 053	731, 633	15, 079	253, 672	....
	value	$43, 427	$280, 478	$5, 636	$97, 785	....
Rye	bushels	301, 314	19, 578	751, 455	2, 658, 817	321, 570
	value	$218, 269	$14, 737	$535, 023	$1, 945, 339	$248, 322
Rye-flour	barrels	....	....	....	....	....
	value	....	....	....	....	....
Wheat	bushels	54, 664, 732	4, 337, 091	33, 573	4, 817, 537	2, 379, 013
	value	$73, 838, 541	$5, 801, 914	$43, 269	$6, 345, 876	$3, 225, 909
Flour	barrels	1, 615, 479	445	8, 261	18, 431	22, 799
	value	$9, 770, 068	$2, 581	$53, 350	$104, 550	$141, 696
Other grains	value	$464, 478	$425	$9, 428	$14	....
Other preparations of grain	value	$1, 410, 548	$2, 764	$22, 959	$26, 353	$738
Rice	pounds	33, 957	35, 995	20, 167	....	....
	value	$2, 370	$2, 555	$1, 187	....	....
Total values		$125, 819, 463	$7, 657, 563	$1, 764, 517	$9, 362, 071	$5, 671, 707

Products.		British America.	Mexico, Central and South America.	West Indies.	Other countries.	Total of each export.
Barley	bushels	308, 172	4, 198	....	34, 961	3, 921, 501
	value	$136, 163	$3, 404	....	$23, 437	$2, 565, 736
Bread, &c	pounds	190, 346	3, 707, 885	8, 694, 315	1, 781, 437	14, 392, 231
	value	$12, 040	$209, 782	$416, 179	$91, 324	$730, 317
Corn	bushels	7, 633, 468	721, 336	690, 055	659, 214	85, 461, 098
	value	$3, 435, 504	$551, 259	$435, 803	$421, 102	$48, 030, 358
Corn-meal	barrels	232, 947	15, 800	174, 453	1, 457	432, 753
	value	$681, 610	$50, 054	$572, 599	$7, 516	$1, 336, 187
Oats	bushels	2, 267, 059	21, 799	250, 865	66, 319	3, 715, 479
	value	$692, 691	$11, 034	$115, 673	$31, 196	$1, 277, 920
Rye	bushels	144, 831	112	....	10, 235	4, 207, 912
	value	$82, 138	$121	....	$7, 790	$3, 051, 739
Rye-flour	barrels	379	461	6, 122	....	6, 962
	value	$1, 892	$1, 982	$26, 901	....	$30, 775
Wheat	bushels	5, 679, 107	226, 461	30, 386	237, 061	72, 404, 961
	value	$6, 945, 515	$295, 291	$45, 184	$330, 517	$96, 872, 016
Flour	barrels	423, 331	974, 788	628, 160	255, 639	3, 947, 333
	value	$2, 610, 704	$6, 731, 449	$4, 031, 698	$1, 649, 625	$25, 095, 721
Other grains	value	$42, 562	$62, 257	$482, 202	$16, 067	$1, 077, 433
Other preparations of grain	value	$31, 117	$65, 673	$87, 155	$62, 332	$1, 709, 639
Rice	pounds	83, 072	238, 707	48, 381	170, 826	631, 105
	value	$3, 405	$13, 904	$2, 923	$7, 609	$33, 953
Total values		$14, 675, 341	$7, 996, 210	$6, 216, 317	$2, 646, 515	$181, 811, 794

COTTON AND COTTON MANUFACTURES.—Our exports of cotton and cotton manufactures rose in aggregate value from $183,253,248 to $191,470,144, but this increase is all due to raw material, as the value of cotton manufactures shows a decline from $12,134,740 to $11,438,660,

Our export of sea-island slightly increased, and all went, as in 1877, to the United Kingdom and France. Of other raw cotton nearly the whole was shipped to European countries; British America and Mexico took 23,326 bales, and 10 bales went to one of the ports of Africa. The United Kingdom slightly lowered her demand for raw material, while continental Europe took an enlarged quantity, especially France, Germany, Belgium, and Netherlands. Of uncolored fabrics, the largest shipment, 30,313,831 yards, was to China; England, the next in order, took 10,906,738 yards. Our total export of uncolored cottons shows an increase of 11,759,045 yards; colored cottons an increase of 8,164,009 yards. The value of these two classes increased $1,092,019, but this was more than counterbalanced by the decline of $1,788,099 in the value of "other manufactures." In regular lines of export the figures of 1878 show an encouraging advance, but in miscellaneous articles the trade has been less fortunate. The following table shows the cotton movement abroad:

Products.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	Other European countries.
Sea-island	bales	13,507	2,948	....	....	....
	pounds	5,320,326	1,004,821	....	....	....
	value	$1,261,630	$354,584	....	....	....
Other	bales	2,180,759	494,759	256,210	89,170	332,116
	pounds	1,034,628,099	235,026,160	121,649,103	42,145,758	157,249,737
	value	$116,169,421	$25,600,909	$13,339,719	$4,589,378	$17,559,107
Colored goods	yards	4,215,758	8,150	55,893	57,591	....
	value	$345,563	$865	$4,296	$5,102	....
Uncolored goods	yards	11,835,128	23,294	699,190	284,884	....
	value	$1,064,321	$1,823	$74,356	$25,358	....
	value	$163,050	$6,055	$37,582	$5,664	$27
Total value		$119,003,985	$25,964,236	$13,455,953	$4,625,502	$17,559,134
Raw material	bales	2,194,266	497,707	256,210	89,170	332,116
	pounds	1,039,948,425	236,030,981	121,649,103	42,145,758	157,449,737
	value	$117,431,051	$25,955,493	$13,339,719	$4,589,378	$17,559,107
Manufactures	value	$1,572,934	$8,743	$116,234	$36,124	$27

Products.		British America.	Mexico, Central and South America.	West Indies.	All other countries.	Total export to each country.
Sea-island	bales	....	....	....	....	16,455
	pounds	....	....	....	....	6,325,147
	value	....	....	....	....	$1,616,214
Other	bales	14,794	7,522	....	10	3,375,340
	pounds	7,082,535	3,422,162	....	4,810	1,601,208,364
	value	$798,951	$357,210	....	$575	$178,415,270
Colored goods	yards	1,218,356	21,573,389	5,117,530	5,518,646	37,765,313
	value	$102,661	$1,672,844	$432,961	$395,618	$2,959,910
Uncolored goods	yards	3,604,080	21,778,838	3,262,565	47,040,213	88,528,192
	value	$369,983	$1,681,454	$323,460	$3,512,708	$7,053,463
	value	$765,478	$227,798	$57,501	$162,132	$1,425,287
Total value		$2,037,073	$3,939,306	$813,922	$4,071,033	$191,470,144
Raw material	bales	14,794	7,522	....	10	3,391,795
	pounds	7,082,535	3,422,162	....	4,810	1,607,533,511
	value	$798,951	$357,210	....	$575	$180,031,484
Manufactures	value	$1,238,122	$3,582,096	$813,922	$4,070,458	$11,438,660

WOOD AND ITS MANUFACTURES.—This branch of our export shows a decline of over two and a half millions of dollars. The falling off is chiefly in pot and pearl ashes, in sawed timber, boards and shooks, in logs, masts, telegraph poles and other whole timber. On the other hand, the different branches of wooden manufacture show an increased shipment, as also rosin, turpentine, spirits of turpentine, and tar.

The United Kingdom received $6,796,104, against $9,220,006 in 1877; the West Indies, $3,865,728, against $4,896,841; British America, $2,344,054, against $2,914,877; Germany, $1,297,470, against $1,214,020; France, $758,282, against $568,846. Other European countries show an increased demand for this kind of products.

MISCELLANEOUS.—The leading miscellaneous products show a considerable decline in the values exported, but, as in other articles, this decline is due largely to a decline in prices. Hops, for instance, are doubled in quantity; cotton-seed oil nearly tripled; oil-cake, starch, and cotton-seed show an enormous increase. On the other hand, refined sugar, molasses, tobacco leaf, and a few other items show a marked decline. The following table shows the distribution of our miscellaneous exports:

Products.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	Other European countries.
Fruits	value	$493, 342	$17, 462	$102, 609	$63, 038	$10
Hemp and its products	do	$425, 774	$55, 838	$32, 020	$73, 260	$54, 300
Hops	pounds	17, 747, 291	21, 750	55, 006	810	....
	value	$2, 076, 115	$700	$7, 120	$165	....
Spirits	gallons	27, 953	1, 113, 154	86	40	347, 250
	value	$22, 751	$389, 990	$247	$119	$111, 491
Oil-cake	pounds	332, 518, 447	....	67, 451	1, 191, 465	....
	value	$4, 905, 642	....	$1, 128	$12, 864	....
Oil, cotton-seed	gallons	75, 486	1, 227, 673	92	71	3, 687, 682
	value	$40, 267	$609, 195	$48	$36	$1, 864, 025
Seed, cotton	pounds	15, 805, 109	....	950, 000	....	....
	value	$164, 280	....	$15, 219	....	....
Starch	pounds	1, 124, 621	1, 607	4, 494, 448	3, 755, 151	80, 479
	value	$74, 597	$124	$206, 810	$153, 376	$2, 413
Sugar, refined	pounds	17, 576, 035	....	190, 989	....	38, 646
	value	$1, 835, 890	....	$20, 022	....	$3, 773
Molasses	gallons	1, 331, 405	....	60, 596	42	1, 209
	value	$315, 966	....	$18, 966	$24	$346
Tobacco, leaf	pounds	63, 597, 496	30, 388, 775	76, 104, 768	25, 005, 648	57, 671, 597
	value	$8, 200, 804	$2, 283, 512	$5, 761, 099	$1, 798, 038	$4, 109, 779
Tobacco, manufactured	value	$962, 336	$3, 905	$164, 524	$180, 632	....
Potatoes	bushels	7, 999	....	21	....	....
	value	$6, 062	....	$20	....	....
Ginseng	pounds	27, 802	....	....	....	....
	value	$34, 950	....	....	....	....
Total values to each country		$19, 558, 776	$3, 360, 726	$6, 329, 832	$2, 281, 552	$6, 146, 137

Products.		British America.	Mexico, Central and South America.	West Indies.	Other countries.	Total of each export.
Fruits	value	$429, 249	$73, 656	$71, 109	$128, 631	$1, 379, 106
Hemp and its products	do	$76, 697	$63, 235	$97, 164	$342, 674	$1, 220, 962
Hops	pounds	99, 605	56, 603	8, 698	469, 019	18, 458, 782
	value	$9, 202	$7, 800	$1, 107	$50, 664	$2, 152, 873
Spirits	gallons	12, 337	747, 877	375	677, 579	2, 926, 651
	value	$15, 344	$296, 462	$617	$312, 251	$1, 149, 272
Oil-cake	pounds	91, 223	66, 722	8, 495, 585	15, 546	342, 446, 439
	value	$1, 712	$370	$172, 039	$1, 408	$5, 095, 163
Oil, cotton-seed	gallons		400	525	420	4, 992, 349
	value		$217	$260	$275	$2, 514, 323
Seed, cotton	pounds			2, 000	525	16, 757, 634
	value			$20	$83	$179, 602
Starch	pounds	175, 095	2, 913, 184	339, 526	111, 274	12, 995, 385
	value	$11, 686	$128, 508	$19, 610	$8, 397	$605, 521
Sugar, refined	pounds	11, 151, 836	12, 345, 826	1, 961, 482	775, 595	44, 040, 409
	value	$1, 064, 345	$1, 294, 726	$208, 301	$81, 091	$4, 508, 148
Molasses	gallons	64, 620	4, 587	435	14, 163	1, 477, 057
	value	$24, 632	$1, 406	$187	$4, 226	$365, 753
Tobacco, leaf	pounds	6, 813, 762	2, 778, 693	2, 386, 732	19, 225, 722	283, 973, 193
	value	$874, 481	$325, 686	$278, 871	$1, 170, 895	$24, 803, 165
Tobacco, manufactured	value	$221, 609	$203, 158	$378, 895	$1, 566, 268	$3, 681, 327
Potatoes	bushels	19, 972	62, 957	628, 460	25, 000	744, 409
	value	$9, 082	$50, 283	$450, 101	$26, 045	$541, 593
Ginseng	pounds		3, 013		390, 580	421, 395
	value		$4, 000		*$458, 297	$497, 247
Total values to each country		$2, 738, 039	$2, 449, 507	$1, 678, 281	$4, 151, 205	$48, 694, 055

*Nearly the whole export of ginseng goes to Hong-Kong and Japan.

The export to the United Kingdom fell off nearly $3,000,000; that to Germany about $2,000,000; that to Belgium and Netherlands about $1,000,000; but France and other European countries show a very considerable increase. British America shows a falling off, but Mexico, Central and South America, and the West Indies show a general increase. There is no doubt that the trade of 1878, at lower values, shows an increased movement in this class of products. This may also be said of our agricultural exports generally. The preference for raw material over manufactures, however, is still noted in the foreign demand for our products.

MARKET PRICES OF FARM

The following quotations represent as nearly as practicable

Products.	January.	February.	March.	April.	May.
NEW YORK.					
Flour:					
Superfine State and Western ....bbl.	$4 50 to $5 00	$4 20 to $4 50	$4 40 to $4 90	$4 40 to $4 90	$4 25 to $4 65
Extra State ....do.	5 25 to 6 85	5 00 to 6 85	5 10 to 6 50	5 00 to 6 50	4 85 to 6 25
Extra to choice Western ....bbl.	5 20 to 9 00	4 90 to 8 50	5 00 to 8 50	4 95 to 8 00	4 75 to 8 00
Common to fair Southern extra ....bbl.	5 40 to 5 85	5 25 to 5 60	5 40 to 5 85	5 20 to 5 50	5 10 to 5 40
Good to choice ....do.	6 to to 7 25	5 75 to 7 00	6 00 to 7 00	5 60 to 6 75	5 50 to 6 50
Wheat:					
No. 1 spring ....bush.	1 36 to 1 38	1 31 to 1 33	1 30 to 1 32	1 33 to 1 35	1 28 to 1 30
No. 2 spring ....do..	1 30 to 1 33	1 25 to 1 29	1 25 to 1 28	1 23 to 1 30	1 22 to 1 25
Red winter ....do..	1 35 to 1 42	1 32 to 1 38	1 32 to 1 37	1 30 to 1 40	1 26 to 1 36
Amber ....do..	1 40 to 1 44	1 35 to 1 42	1 35 to 1 40	1 33 to 1 41	1 30 to 1 37
White ....do..	1 43 to 1 52	1 35 to 1 44	1 36 to 1 43	1 38 to 1 47	1 33 to 1 42
Corn ....do..	53 to 64	46 to 61	53 to 56	47 to 56	48 to 55
Oats ....do..	37½ to 42	33 to 39	33 to 40	33 to 39	33 to 39
Rye ....do..	72 to 76	70 to 75	70 to 76	72 to 79	70 to 75
Barley ....do..	68 to 1 00	65 to 1 00	60 to 80	58 to 90	58 to 88
Hay:					
Baled, first quality..ton.	14 00 to 17 00	15 00 to 17 00	14 00 to 16 00	14 00 to 17 00	14 00 to 16 00
Baled, second quality do.	12 00 to 13 00	13 00 to 14 00	13 00 to 14 00	12 00 to 13 00	11 00 to 12 00
Beef:					
Mess ....bbl	9 00 to 12 00	11 00 to 12 00	9 00 to 12 00	9 00 to 12 00	10 00 to 11 50
Extra mess ....do.	12 50 to 13 00	13 00 to 13 50	12 50 to 13 50	12 50 to 13 50	12 00 to 12 25
Pork:					
Mess ....bbl.	12 25 to 13 00	11 50 to 11 75	10 75 to 11 25	9 75 to 10 75	9 40 to 9 75
Extra prime ....do.	7 00 to 10 50	9 25 to 9 50	7 00 to 9 25	7 00 to 8 50	6 50 to 9 00
Prime mess ....do.	11 00 to 12 00	....	11 50 to 14 00	10 50 to 12 00	10 50 to 13 25
Lard ....cental.	5 62 to 8 62	7 65 to 7 85	5 50 to 7 55	5 37½ to 8 00	5 25 to 7 62
Butter:					
Western ....lb.	11 to 35	8 to 41	11 to 43	11 to 38	10 to 25
State ....do.	14 to 35	12 to 35	14 to 32	14 to 35	22 to 25
Cheese:					
State factory ....lb.	7½ to 13	10 to 14	7½ to 14	9 to 13	9 to 13
Western factory ....do.	5 to 13	5 to 13½	5 to 13½	5 to 13	5 to 13
Sugar, fair to prime refining ....lb.	7⅜ to 7⅝	7¼ to 7⅝	7⅜ to 7⅝	7⅛ to 9¼	7⅛ to 7⅜
Cotton:					
Ordinary to good ordinary ....lb.	9¾ to 10½	8¾ to 10	8 to 9 5/16	7 15/16 to 9¼	7 15/16 to 9¼
Low middling to good middling ....lb.	11 to 11¾	10⅝ to 11⅝	10 3/16 to 11⅝	10 1/16 to 11¼	10⅛ to 11¼
Tobacco:					
Lugs ....lbs	3 to 5	3 to 6	3 to 4½	3 to 4½	2¼ to 4½
Leaf of common to medium ....lb.	4½ to 8	5 to 7½	5 to 7½	5 to 7½	4 to 7½
Wool:					
American XXX and picklock ....lb.	48 to 52	50 to 52	45 to 48	44 to 46	42 to 45
American X and XX .do.	36 to 46	37 to 46	35 to 43	35 to 44	34 to 42
American combing ..do.	48 to 58	48 to 54	45 to 56	45 to 55	45 to 50
Pulled ....do.	18 to 43	18 to 42	18 to 40	18 to 40	20 to 40
California spring clip.do.	13 to 28	13 to 30	13 to 27	13 to 25	13 to 25
California fall clip ...do.	10 to 22	10 to 22	10 to 19	12 to 18	10 to 18
BOSTON.					
Flour:					
Western spring, superfine ....bbl.	4 00 to 4 50	4 00 to 4 50	4 00 to 4 50	4 00 to 4 50	3 50 to 4 00
Common spring, extra, bbl	5 00 to 5 50	4 75 to 5 25	4 75 to 5 25	5 00 to 5 25	4 75 to 5 25
Good to fancy Northwestern spring ...bbl.	6 00 to 9 25	5 50 to 8 75	5 25 to 8 50	5 25 to 8 50	5 25 to 8 25
Good to fancy Western winter ....bbl.	6 50 to 8 00	5 75 to 7 50	5 75 to 7 50	6 00 to 7 50	5 75 to 7 00
Southern family .....do.	6 50 to 8 75	6 25 to 8 75	6 00 to 8 25	6 00 to 7 75	5 75 to 7 75
Wheat ....bush.	1 29 to 1 55½	1 24 to 1 46	1 23 to 1 44	1 24 to 1 46	1 22 to 1 47
Corn ....do..	59 to 61	50 to 58	50 to 56	50 to 58	50 to 57
Oats ....do..	38½ to 45	36 to 43	35 to 42	35½ to 43	36 to 43
Rye ....do..	76 to 77	73 to 75	73 to 75	75 to 77	75 to 76
Barley ....do..	80 to 1 10	70 to 1 00	70 to 1 00	70 to 1 00	65 to 90
Hay:					
Eastern and Northern, ton	12 00 to 19 00	12 00 to 19 00	12 00 to 19 00	12 00 to 19 00	12 00 to 19 00
Western, choice ....ton.	17 00 to 18 00	17 00 to 18 00	17 00 to 18 00	16 00 to 17 00	16 00 to 17 00
Beef:					
Mess ....bbl.	12 00 to 12 50	12 00 to 12 50	10 00 to 11 00	10 00	10 00 ....

PRODUCTS FOR 1878.

the state of the market at the beginning of each month.

June.	July.	August.	September.	October.	November.	December.
$3 25 to $4 00	$3 25 to $3 80	$3 50 to $3 90	$3 40 to $3 90	$3 40 to $3 80	$3 00 to $3 50	$3 25 to $3 75
4 25 to 6 25	4 00 to 5 85	4 10 to 6 00	4 10 to 6 00	3 85 to 5 75	3 70 to 3 85	3 90 to 4 00
4 15 to 8 00	3 95 to 7 50	4 05 to 8 25	4 00 to 8 25	3 90 to 8 00	3 65 to 8 95	3 85 to 8 25
4 50 to 4 85	4 30 to 4 65	4 40 to 4 85	4 25 to 4 65	4 15 to 4 40	3 90 to 4 20	3 95 to 4 40
5 00 to 6 50	4 75 to 6 25	5 00 to 6 50	4 75 to 6 50	4 50 to 6 25	4 25 to 5 75	4 50 to 6 00
1 10 to 1 12	1 06 to 1 07	1 10 to 1 11	1 15 to 1 17	....	....	....
1 05 to 1 08	1 02 to 1 04	96 to 1 08	1 08 to 1 12	96 to 97	93 to 96	98 to 1 00
1 08 to 1 18	1 01 to 1 13	90 to 1 10	1 07 to 1 08	1 05¼ to 1 05½	1 04 to 1 04½	1 07¾ to 1 08¼
....	....	....	97 to 1 11	95 to 1 06	98 to 1 05	1 02 to 1 08½
1 15 to 1 25	1 12 to 1 20	1 05 to 1 20	1 06 to 1 18	1 02 to 1 10	1 02 to 1 08	1 02 to 1 11
42 to 54	41 to 55	45 to 56	46 to 50	46 to 53	45 to 53	41 to 52
26 to 34	28 to 37	31 to 37	26 to 38	26 to 37	27 to 33	29 to 35
62 to 68	57 to 63	60 to 68	58 to 64	56 to 64	58 to 63	57 to 62
58 to 87	58 to 75	45 to 85	45 to 90	1 00 to 1 20	1 00 to 1 30	75 to 95
13 00 to 15 00	12 00 to 15 50	12 00 to 15 00	13 00 to 15 00	13 00 to 15 00	12 00 to 15 00	13 00 to 14 00
10 00 to 11 00	9 00 to 11 00	9 00 to 12 00	9 00 to 10 00	8 00 to 9 00	8 00 to 9 00	10 00 to 12 00
9 00 to 11 00	9 00 to 10 50	10 00 to 11 00	10 00 to 11 00	10 00 to 11 00	10 00 to 11 00	10 00 to 11 00
11 50 to 12 50	11 00 to 12 00	11 00 to 12 00	11 00 to 12 00	11 00 to 12 00	11 00 to 12 00	11 00 to 12 00
8 50 to 9 75	10 25 to 10 50	10 25 to 10 75	9 50 to 9 75	8 75 to 9 00	7 75 to 8 50	7 25 to 7 75
7 00 to 8 50	9 00 to 9 75	9 75 to 10 00	9 00 to 9 75	9 75 to 10 00	9 00 to 9 50	8 50 to 9 00
10 00 to 12 50	10 00 to 12 50	11 00 to 12 00	11 00 to 12 50	11 00 to 12 50	10 25 to 12 00	9 00 to 11 00
6 85 to 6 97	6 75 to 7 87	7 25 to 8 30	6 50 to 7 75	6 50 to 7 30	6 00 to 7 00	5 75 to 6 62
8 to 20	7 to 20	7 to 22	7 to 23	8 to 25	9 to 26	6 to 27
10 to 20	9 to 20	9 to 22	9 to 24	10 to 27	10 to 25	10 to 28
5 to 8	5 to 9	5 to 8	5 to 8¾	5 to 9¾	5 to 9½	5 to 9½
2 to 8	2 to 9	5 to 7½	2 to 8¼	2 to 9	2 to 9	2 to 9
7¼ to 7½	7¼ to 7⅜	7⅛ to 7½	7 to 7⅜	7⅛ to 7⅞	7⅛ to 7⅜	6¾ to 7
9⅛ to 10¼	9 3/16 to 9 15/16	10 to 11	10 to 11 5/16	8⅞ to 9 15/16	7 3/16 to 8¾	7⅛ to 8⅛
11 to 11⅞	11 1/16 to 11⅞	11½ to 12¼	11⅞ to 12¼	10½ to 11⅛	9½ to 9 15/16	8 13/16 to 9¾
2¾ to 4½	2½ to 6½	2½ to 6½	2¾ to 5	2¼ to 5	2 to 4	2½ to 5
4½ to 7	4½ to 10	4½ to 7½	4¼ to 7½	4½ to 8	5 to 8	4½ to 8
40 to 43	40 to 43	40 to 42	39 to 42	39 to 42	37 to 40	37 to 39
32 to 38	30 to 37	30 to 38	32 to 38	32 to 38	30 to 36	30 to 36
37 to 44	35 to 42	35 to 42	38 to 45	38 to 45	36 to 42	36 to 42
18 to 40	18 to 34	18 to 36	18 to 37	18 to 37	18 to 37	18 to 36
12 to 30	12 to 30	12 to 30	12 to 30	12 to 30	12 to 26	12 to 25
10 to 19	10 to 19	10 to 19	10 to 19	10 to 19	10 to 18	10 to 20
3 50 to 3 75	3 00 to 3 50	3 00 to 3 50	3 00 to 3 50	3 00 to 3 50	3 00 to 3 25	3 00 to 3 25
4 25 to 4 75	4 25 to 4 75	4 25 to 4 75	4 25 to 4 75	4 25 to 4 75	3 75 to 4 25	3 75 to 4 25
5 25 to 7 50	4 50 to 7 50	4 50 to 8 00	4 00 to 9 00	4 50 to 8 00	4 00 to 8 50	4 00 to 8 00
5 50 to 6 50	5 00 to 6 25	4 75 to 6 00	5 00 to 6 25	4 75 to 6 00	4 50 to 5 75	4 75 to 6 00
5 50 to 7 25	5 00 to 6 75	5 00 to 6 75	5 25 to 6 75	5 00 to 6 75	....	....
1 07 to 1 23	90 to 1 16	1 03 to 1 26	95 to 1 22	95 to 1 21	84 to 1 16	90 to 1 13
45 to 53	47 to 51	47 to 54	54 to 58	51 to 56	50½ to 55	47 to 53
31 to 39	32 to 41	32 to 40	32 to 42	29 to 39	29½ to 39	32½ to 40
75 to 80	62 to 65	68 to 72	63 to 65	58 to 60	60 to 63	63 to 65
73 to 85	73 to 85	..........1 15	....	....	1 00 to 1 30	90 to 1 25
12 00 to 19 00	10 00 to 18 00	10 00 to 18 00	10 00 to 17 00	9 00 to 18 00	8 00 to 16 00	8 00 to 17 00
16 00 to 17 00	15 00 to 17 00	15 00 to 17 00	14 00 to 16 00	14 00 to 16 00	14 00 to 16 00	15 00 to 16 00
10 00..........	9 00 to 11 00	9 00..........	10 00..........	9 50 to 10 00.	9 50 to 10 00	9 50 to 10 00

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
BOSTON—Continued.					
Beef—Continued:					
Extra mess ....bbl.	$13 00 to $13 50	$12 50 to $13 00	$12 00 to $12 50	$12 50	$12 00 ....
Family or plate.......do.	14 50 to 15 50	14 00 to 15 00	14 00 to 15 00	14 00 to $15 00	12 00 to $13 00
Pork:					
Prime ....bbl.	9 50 to 11 00	9 50 to 11 00	8 00 to 10 00	9 00 to 10 50	8 50 to 9 25
Mess ....do.	13 25 to 13 50	12 00 to 12 50	11 50 to 12 00	10 75 to 11 00	10 00 to 10 25
Lard ....lb.	9 to 9¼	8 to 8¾	7¾ to 8¼	7½ to 8¼	7¼ to 7½
Butter:					
New York and Vermont, pound	12 to 35	10 to 38	10 to 38	7 to 30	18 to 25
Western ....lb.	10 to 35	9 to 38	9 to 38	7 to 35	18 to 25
Cheese:					
New York and Vermont factory ....lb.	9 to 13¼	10 to 13½	10½ to 14	10 to 13	8 to 13
Western factory .....lb.	9 to 13	9 to 13¼	10 to 14	9 to 12½	7 to 12½
Sugar, fair to good refining ....lb.	7½ to 7¾	7⅜ to 7⅝	7⅜ to 7⅝	7½ to 7¾	7⅛ to 7⅜
Cotton:					
Ordinary to good ordinary ....lb.	9¾ to 10¾	8⅝ to 10	8¼ to 9¾	7 to 9½	8 to 9¼
Low middling to good middling............lb.	11 to 12	10¾ to 11¾	10⅜ to 11¾	9⅞ to 11¼	10 to 11¼
Wool:					
Ohio and Pennsylv'a.lb.	37 to 50	37 to 46	35 to 45	34 to 42	33 to 42
Michigan.............do.	36 to 42	36 to 42	35 to 42	30 to 39	30 to 37
Other western........do.	37 to 42	37 to 42	35 to 42	30 to 38	30 to 36
Pulled................do.	20 to 43	20 to 46	20 to 43	20 to 43	20 to 40
Combing and delaine.do.	40 to 53	40 to 53	40 to 50	40 to 48	40 to 45
California ....do.	15 to 34	15 to 33	15 to 33	12 to 29	12 to 29
Texas ....do.	20 to 37	16 to 35	14 to 30	12 to 28	12 to 26
PHILADELPHIA.					
Flour:					
Superfine............bbl.	4 25 to 4 50	4 00 to 4 25	4 00 to 4 50	4 00 to 4 50	3 75 to 4 25
Pennsylvania, extra to choice ....bbl.	5 00 to 6 75	5 75 to 6 25	4 50 to 6 25	4 75 to 6 25	4 25 to 6 25
West'n, ex. to choice.do.	5 50 to 6 50	5 60 to 6 25	5 50 to 6 25	5 50 to 6 25	5 25 to 6 25
Wheat:					
White ....bush.	1 45 to 1 50	1 38 to 1 43	1 37 to 1 40	1 38 to 1 42	1 38 to 1 40
Amber ....do..	1 45 to 1 46	1 34 to 1 36	1 36 to 1 38	1 35 to 1 38	1 35 to 1 37
Red ....do..	1 38 to 1 42	1 26 to 1 33	1 30 to 1 33	1 29 to 1 34	1 29 to 1 32
Rye ....do..	68 to 73	68 to 70	68 to 70	68 to 70	68 to 70
Barley..................do..	50 to 1 05	35...........	....	40 to 1 00	40 to 1 00
Corn....................do..	54 to 58¼	49 to 54	44 to 53½	46 to 53½	46 to 52¼
Oats ....do..	35 to 38	35 to 39	32½ to 35½	33 to 36	32 to 37
Hay, baled:					
Middle State ....ton.	15 00 to 16 00	14 00 to 16 00	13 00 to 15 00	12 00 to 14 00	12 00 to 15 00
Western ....do.	11 00 to 12 00	12 00 to 14 00	12 00 to 14 00	11 00 to 13 00	11 00 to 12 50
Beef:					
Worthman's city family.................bbl.	15 00 to 15 50	15 00 to 15 50	15 00 to 15 50	14 00 to 14 50	14 00 to 14 50
No. 1 ....do	11 50 to 12 50	11 50 to 12 50	11 50 to 12 00	12 00 to 12 50	12 00 to 12 50
Pork:					
Mess ....bbl.	12 75 to 13 00	11 75 to 12 25	11 50 to 12 25	10 25 to 10 50	9 75 to 10 25
Prime mess ....do.	11 50 to 11 75	10 75..........	10 50 to 10 75	9 00 to 9 50	9 00 to 9 25
Extra prime..........do.	10 00 to 11 00	9 50..........	10 00..........	9 00..........	9 00..........
Lard.................cental	7 50 to 8 25	7 00 to 8 00	7 25 to 7 62½	6 75 to 7 50	6 25 to 7 62½
Butter:					
Choice Middle State..lb.	24 to 33	25 to 35	28 to 40	22 to 40	15 to 30
Choice western.......do.	20 to 24	19 to 24	22 to 26	24 to 27	16 to 18
Cheese:					
New York factory ...lb.	6 to 13½	7 to 14	7 to 14	7 to 13½	7 to 13
Western factory.....do.	6 to 13¼	6 to 13	6 to 13	6 to 12¾	6 to 12
Sugar, fair to good refining ....do.	7⅜ to 7⅝	7¼ to 7½	7⅜ to 7⅝	7⅛ to 7⅝	7 to 7⅝
Cotton:					
Ordinary to good ordinary ....lb.	9⅞ to 10⅝	9 to 10⅛	8½ to 9⅝	7⅞ to 9¼	8 to 9⅜
Low middling to good middling...........lb.	11 to 11¾	10⅜ to 10 5/16	10⅜ to 11 7/16	10 1/16 to 11¼	10 3/16 to 11⅜
Wool:					
Ohio and Pennsylvania, X to XXX.........lb.	43 to 47	43 to 47	42 to 46	41 to 45	39 to 43
New York and Wisconsin...................lb.	38 to 42	38 to 42	37 to 41	36 to 39	34 to 37
Other Western.......do.	32 to 41	32 to 41	31 to 40	30 to 39	28 to 37
Pulled.................do.	21 to 53	21 to 53	20 to 51	20 to 51	18 to 49
Tub-washed..........do.	30 to 47	30 to 47	29 to 46	28 to 42	26 to 40
California ....do.	12 to 23	12 to 23	11 to 24	11 to 24	9 to 20
Colorado ....do.	15 to 20	15 to 20	14 to 19	13 to 18	11 to 16

PRODUCTS FOR 1878—Continued.

June.	July.	August.	September.	October.	November.	December.
$12 00	$11 00 to $12 00	$11 00	$11 50	$10 00 to $10 50	$10 00 to $10 50	$10 00 to $10 50
12 00 to $13 00	11 50 to 12 00	11 50 to $12 00	12 00 to $12 50	10 00 to 11 00	11 00 to 12 00	10 75 to 11 00
8 00 to 8 50	9 00 to 9 50	9 50 to 10 00	10 00 to 10 25	9 75 to 10 00	9 00 to 9 50	7 75 to 8 00
9 25 to 9 50	10 25 to 10 75	10 62½ to 10 75	10 75 to 11 00	9 50 to 10 00	9 00 to 9 50	8 25 to 9 00
7 to 7¾	7¼ to 7¾	7⅜ to 8	7¾ to 8¼	7 to 7¾	6¾ to 7¼	6½ to 7
10 to 25	9 to 20	9 to 22	9 to 23	9 to 26	8 to 26	8 to 27
8 to 20	7 to 20	6 to 22	6 to 23	6 to 26	6 to 26	6 to 27
4 to 8¾	4 to 8	3 to 7¾	5 to 8½	5 to 9	5 to 9	5 to 9
3 to 8	3 to 8	3 to 7¼	4 to 8	4 to 8½	4 to 9	4 to 8¾
7¼ to 7½	7 3/16 to 7 5/16	7⅛ to 7⅜	7⅛ to 7⅜	7½ to 7¾	7⅛ to 7⅜	6¾ to 7
8⅝ to 10	9½ to 10¾	9⅞ to 11	10½ to 11¾	9¼ to 10½	7⅝ to 8⅞	7½ to 8½
10¾ to 11¾	11⅛ to 12⅛	11⅝ to 12¼	12 to 12¾	10⅞ to 11½	9½ to 10	9 to 10
30 to 40	30 to 40	33 to 42	29 to 40	30 to 40	30 to 40	30 to 40
30 to 36	30 to 35	30	28 to 34	28 to 36	28 to 34	28 to 34
30 to 35	30 to 35	30 to 36	28 to 34	28 to 35	28 to 35	28 to 34
15 to 42	15 to 42	15 to 42	15 to 42	15 to 40	15 to 40	15 to 38
38 to 45	35 to 42	40 to 45	37 to 45	37 to 43	35 to 42	35 to 42
14 to 30	14 to 30	14 to 30	12 to 29	12 to 29	12 to 29	11 to 27
14 to 28	14 to 28	14 to 28	14 to 28	14 to 28	14 to 28	14 to 28
3 00 to 3 50	3 00 to 3 25	3 00 to 3 25	3 00 to 3 25	2 75 to 3 00	2 25 to 2 75	2 25 to 2 75
3 75 to 5 50	3 50 to 5 50	3 37½ to 5 50	3 25 to 5 25	3 25 to 5 25	3 25 to 5 00	3 25 to 4 75
4 00 to 5 75	4 00 to 5 25	4 00 to 6 25	3 75 to 6 25	3 50 to 5 75	4 00 to 5 25	4 00 to 5 25
1 17 to 1 20	1 10 to 1 14	1 00 to 1 08	1 06 to 1 10	1 06 to 1 08	1 04 to 1 06	1 04 to 1 08
1 12 to 1 13	1 00 to 1 12	1 00 to 1 02	1 06 to 1 07½	1 02 to 1 05	1 03 to 1 06	1 06 to 1 08
1 08 to 1 10	90 to 1 05	95 to 1 00	93 to 1 07½	95 to 1 04	1 00 to 1 04	1 02 to 1 06
60 to 84	57 to 58	50 to 56	58 to 60	59 to 61	54 to 56	54 to 56
Season closed.	....	....	....	....	1 00 to 1 42	1 00 ....
35 to 47	35 to 46	44 to 52	51 to 53	47 to 53	47 to 51	35 to 49
28 to 32	26 to 32	29 to 33	26 to 35	26 to 31	25 to 33	25 to 33
11 00 to 12 00	10 00 to 13 00	11 00 to 13 00	8 00 to 12 00	11 00 to 12 00	11 00 to 12 00	11 50 to 12 00
10 00 to 11 00	10 00 to 11 00	9 00 to 10 00	8 00 to 9 00	10 00 to 11 00	9 00 to 11 00	9 00 to 11 00
14 00	12 00	12 00	12 00	12 00	12 00 to 12 50	11 50 to 12 00
12 00	10 00	10 00	10 00	11 00	11 00	11 00 ....
9 50 to 10 25	10 50 to 10 75	10 25 to 10 50	10 25 to 10 75	9 00 to 9 50	8 25 to 8 50	8 25 to 8 75
9 00 to 9 25	9 50 to 10 00	9 50 to 10 00	9 75	9 50	7 50 to 7 75	7 50 to 7 75
9 00	8 50	8 50	9 00	8 50	7 25	7 25 ....
6 25 to 7 50	6 50 to 7 37½	6 50 to 7 75	6 50 to 8 00	6 75 to 8 00	6 00 to 6 75	5 50 to 6 62
9 to 20	9 to 20	12 to 25	12 to 25	17 to 28	16 to 28	14 to 30
9 to 13	9 to 13½	10 to 14	10 to 18	15 to 18	16 to 18	15 to 20
4 to 8½	7 to 8	7 to 8½	7¼ to 9	7½ to 9¾	7¼ to 9	7¼ to 9
4 to 8½	6 to 7½	4 to 8	4 to 8½	4 to 9¼	4 to 8¾	4 to 8¾
7 5/16 to 7½	7 3/16 to 7⅜	7⅛ to 7 5/16	7 3/16 to 7⅜	7½ to 7¾	7⅛ to 7⅜	6¾ to 7
9 to 10¾	9⅜ to 10½	9⅝ to 10¾	10½ to 11½	8¾ to 9 13/16	7⅝ to 8 13/16	7½ to 8 11/16
11 to 12¼	11⅜ to 12⅛	11⅝ to 12⅜	11 5/16 to 12¾	10⅜ to 11	9 7/16 to 10	9 1/16 to 9⅞
22 to 43	35 to 37	36 to 38	34 to 37	34 to 37	34 to 37	34 to 37
34 to 37	32 to 36	32 to 36½	32 to 36	32 to 34	32 to 34	32 to 34
28 to 39	28 to 38	28 to 38	27 to 37	27 to 37	27 to 37	27 to 37
18 to 49	18 to 49	18 to 49	18 to 49	18 to 49	18 to 49	18 to 49
26 to 40	26 to 38	26 to 38	29 to 38	25 to 40	25 to 40	25 to 40
9 to 22	9 to 22	9 to 22	9 to 22	9 to 22	9 to 22	9 to 22
11 to 16	11 to 16	17 to 20	17 to 20	17 to 20	17 to 20	12 to 14

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
BALTIMORE.					
Flour:					
Superfine .... bbl.	$4 00 to $4 50	$3 75 to $4 25	$3 50 to $4 25	$3 50 to $4 25	$4 00 to $4 50
Extra .... do.	4 75 to 6 50	4 00 to 7 00	4 50 to 6 00	4 50 to 6 00	4 75 to 7 00
Family and fancy .... do.	6 00 to 8 00	6 50 to 8 00	6 25 to 7 50	6 25 to 7 50	5 50 to 7 25
Wheat:					
Red .... bush.	1 25 to 1 40	1 20 to 1 32	1 15 to 1 30	1 20 to 1 35	1 20 to 1 32
Amber .... do.	1 40 to 1 45	.... 1 37	1 38	....	....
White .... do.	....	....	....	....	....
Rye .... do.	63 to 65	64 to 66	62 to 64	64 to 65	66 to 68
Oats .... do.	33 to 38	35 to 38	32 to 37	34 to 37	32 to 36
Corn .... do.	51 to 59	46¾ to 57	46½ to 54½	53 to 56½	47 to 54½
Hay:					
Maryland and Pennsylvania .... ton.	14 00 to 17 00	14 00 to 17 00	13 00 to 16 00	13 00 to 16 00	13 00 to 16 00
Western .... do.	....	....	12 00 to 13 00	12 00 to 13 00	12 00 to 13 00
Pork:					
Mess .... bbl.	12 75	11 75 to 12 50	11 50	10 75	10 00 ....
Extra prime .... do.	11 00	11 00	10 50	10 00	9 25 ....
Lard .... cental.	8 50 to 8 75	8 25 to 8 50	8 00 to 8 50	7 75 to 8 00	7 75 to 8 00
Butter:					
Western .... lb.	10 to 20	14 to 23	16 to 25	9 to 25	15 to 22
Eastern .... do.	16 to 30	14 to 33	14 to 31	7 to 35	16 to 23
Cheese:					
Western factory, all grades .... lb.	7 to 12½	11½ to 13	7½ to 13	7 to 12½	5 to 12
Eastern factory, good to choice .... lb.	.... 13½	12½ to 14	12½ to 13	12 to 10½	11 to 12½
Sugar:					
Fair to good refining .lb.	7½ to 7¼	7¼ to 7¾	7⅜ to 7⅝	7⅛ to 7¼	7 3/16 to 7⅜
New Orleans grocery grades .... lb.	6¼ to 8	6¼ to 7¾	7 to 7⅓	7½ to 7½	....
Tobacco:					
Lug .... lb.	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Leaf, common to medium .... lb.	5½ to 8	5 to 8	5½ to 8	5½ to 8	5 to 8
Cotton:					
Ordinary to good ordinary .... lb.	.... 10¼	9 to 10	8 to 9¼	8 to 9	8 to 9
Low middling to good middling .... lb.	10¾ to 11⅜	10⅜ to 11⅞	10¾ to 10⅞	10 to 10⅞	9⅞ to 10⅜
Wool:					
Unwashed .... lb.	25 to 32	25 to 32	25 to 32	23 to 27	22 to 26
Tub-washed .... do.	33 to 42	33 to 42	33 to 42	33 to 38	33 to 36
Fleece-washed .... do.	35 to 36	35 to 36	35 to 36	35 to 36	35 to 36
CINCINNATI.					
Flour:					
Superfine .... bbl.	4 00 to 4 38	3 60 to 3 85	3 50 to 3 75	3 85 to 4 10	3 60 to 4 00
Extra .... do.	5 00 to 5 25	4 65 to 4 90	4 50 to 4 75	4 75 to 5 00	4 60 to 4 85
Family and fancy .... do.	5 65 to 6 75	5 15 to 6 75	5 15 to 6 50	5 40 to 6 50	5 00 to 6 25
Wheat:					
Winter, red .... bush.	1 00 to 1 24	1 15 to 1 18	1 10 to 1 13	1 15 to 1 23	1 10 to 1 18
Amber .... do.	1 25 to 1 28	1 18 to 1 23	1 15 to 1 18	1 21 to 1 23	1 19 to 1 22
White .... do.	.... 1 28	1 18 to 1 23	1 16 to 1 20	1 21 to 1 25	1 20 to 1 25
Corn .... do.	36 to 38	38 to 39	39 to 40½	41 to 42½	42 to 43
Rye .... do.	60 to 62	56 to 75	55 to 63	60 to 62	59 to 61
Barley .... do.	35 to 70	35 to 55	37 to 52	33 to 50	35 to 45
Oats .... do.	28 to 31	28 to 31	28 to 32	29 to 32	28 to 31
Hay:					
Baled, No. 1 .... ton.	9 00 to 10 00	9 00 to 10 50	8 50 to 9 00	9 00 to 10 00	9 00 to 10 00
Lower grades .... do.	7 00 to 8 00	7 50 to 8 50	7 00 to 8 00	7 00 to 8 50	7 00 to 8 50
Pork .... bbl.	.... 11 75	.... 11 00	10 00 to 10 25	10 00 to 10 25	9 00 to 9 25
Lard .... cental.	7 60 to 8 50	7 30 to 8 00	7 00 to 8 00	7 12½ to 7 75	6 75 to 7 50
Butter:					
Choice .... lb.	17 to 21	20 to 26	25 to 27	22 to 25	18 to 25
Prime .... do.	15 to 18	18 to 20	22 to 24	20 to 22	14 to 15
Cheese, prime to choice factory .... lb.	12 to 12½	12½ to 13	13 to 13½	11 to 12½	8½ to 9½
Sugar:					
New Orleans, fair to good .... lb.	6½ to 7¼	6¼ to 7	6½ to 7¼	6¾ to 7½	7 to 7¾
Prime .... do.	7⅛ to 8	7¼ to 7½	7½ to 7¾	7¾ to 8	8 to 8¼
Peanuts, bush	3 00 to 4 75	3 00 to 4 75	3 00 to 5 00	3 37½ to 6 50	4 00 to 7 00
Cotton:					
Ordinary to good ordinary .... lb.	9½ to 9⅝	8⅜ to 9	8 to 8½	7⅝ to 8⅜	7¼ to 8⅜
Low middling to good middling .... lb.	10⅛ to 11	10 to 11	9¾ to 11	9⅜ to 10⅜	9⅜ to 10¼

PRODUCTS FOR 1878—Continued.

June.	July.	August.	September.	October.	November.	December.
$3 25 to $4 25	$2 25 to $3 00	$2 00 to $3 25	$2 50 to $3 25	$2 75 to $3 50	$2 75 to $3 50	$2 62 to $3 50
4 25 to 6 50	3 50 to 6 00	3 25 to 6 25	3 50 to 6 25	3 75 to 6 00	3 75 to 5 75	3 75 to 6 00
5 00 to 6 75	4 75 to 5 75	4 50 to 6 50	4 75 to 7 00	4 75 to 6 25	4 50 to 7 00	4 25 to 7 00
95 to 1 12	77 to 95	75 to 1 05	75 to 1 10	75 to 1 06	80 to 1 06	88 to 1 06½
1 14 to 1 15	1 05 to 1 06	....	....	....	....	....
....	....	....	....	....	....	....
56	50 to 52	50 to 53	54 to 56	53 to 56	60 to 62	52 to 57
30 to 32	29 to 35	32 to 36	25 to 28	26 to 29½	26 to 30	28 to 31
39½ to 47¾	41 to 48½	43½ to 54	51½ to 54	47 to 56	42 to 48	39 to 46½
12 00 to 15 00	11 00 to 15 00	10 00 to 14 00	11 00 to 14 00	11 00 to 14 00	11 00 to 14 00	10 00 to 13 00
10 00 to 12 00	10 00 to 12 00	6 00 to 11 00	7 00 to 11 00	7 00 to 11 00	7 00 to 11 00	7 00 to 10 00
9 50	10 50	10 75	11 00 to 11 25	9 75	8 75 to 9 00	8 50 ....
8 75 to 9 00	9 00	9 00	10 00 to 10 50	....	8 75 to 9 00	8 00 to 8 50
7 00 to 7 50	7 62½ to 8 00	7 87½ to 8 25	8 25 to 8 50	7 75 to 8 00	7 25	6 75 to 7 00
10 to 14	8 to 13	8 to 15	10 to 17	16 to 19	12 to 25	10 to 30
8 to 12	8 to 12	8 to 12	16 to 23	13 to 23	13 to 23	13 to 23
5 to 9	5 to 8	4 to 8	4 to 8	5 to 9	4 to 9	3 to 8
8 to 10	8 to 10	8 to 10	8½ to 9½	8½ to 9¾	9 to 10	8½ to 9½
7 5/16 to 7½	7 3/16 to 7¾	7⅛ to 7 5/16	7⅛ to 7 5/16	7½ to 7¾	7 3/16 to 7⅜	6¾ to 7
....	....	....	....	....	....	5 7/16 to 7⅛
3 to 6	3 to 6	3 to 5½	3 to 6	3 to 6	3 to 6	3½ to 6
5 to 8	5¼ to 8	5 to 8	5 to 8	5 to 8	5½ to 8	5½ to 8
8½ to 9¾	9 to 10½	9 to 10⅛	11 to 11½	..........9½	8 to 9	8 ....
10¾ to 11⅛	11 to 12	10½ to 12¼	11⅜ to 12½	10⅛ to 10⅝	9⅞ to 10¾	8½ to 9
22 to 26	20 to 25	22 to 26	21 to 25	21 to 25	21 to 24	19 to 22
33 to 36	30 to 34	32 to 36	30 to 35	30 to 35	30 to 35	28 to 31
35 to 36	35 to 36	33 to 35	32 to 33	32 to 33	32 to 33	30 to 31
3 25 to 3 75	2 25 to 3 25	2 25 to 3 00	2 40 to 3 25	2 25 to 3 10	2 00 to 3 00	2 25 to 3 00
4 25 to 4 50	3 75 to 4 00	3 65 to 3 90	3 75 to 4 00	3 75 to 3 90	3 50 to 3 75	3 40 to 3 65
5 25 to 5 40	4 25 to 5 50	4 00 to 5 60	5 00 to 5 85	4 10 to 5 50	4 00 to 5 00	3 75 to 4 40
1 00 to 1 05	90	85 to 95	91 to 94	88 to 91	85 to 90	90 to 93
1 03 to 1 07	87 to 90	93 to 96	92 to 94	88 to 91	88 to 90	90 to 93
1 03 to 1 07	87 to 88	98	97 to 98	93	90 to 93	96 to 97
41 to 43	40 to 42	40 to 43	41 to 44	39 to 42	32 to 37	32 to 33
55 to 57	55 to 57	50 to 53	45 to 54	45 to 53	40 to 49	50 to 52
49 to 52	43 to 48	55 to 1 00	65 to 1 10	50 to 1 15	65 to 1 12	55 to 1 10
26 to 28	27 to 30	22 to 31	20 to 27	22 to 26	20 to 24	22½ to 24½
8 00 to 9 00	9 00 to 10 00	10 00 to 11 00	8 00 to 9 00	10 00 to 11 00	9 00 to 10 00	9 00 to 10 00
6 00 to 7 00	6 00 to 8 00	7 00 to 9 00	6 00 to 7 00	7 50 to 9 50	7 50 to 8 50	7 50 to 8 50
9 25 to 9 50	9 75 to 10 00	10 75 to 11 00	9 50 to 10 25	8 50 to 9 00	7 25 to 7 50	6 75 to 8 00
6 70 to 6 85	6 80 to 6 95	7 25 to 8 50	6 60 to 8 25	6 30 to 7 50	5 80 to 6 50	5 65 to 5 67½
18 to 20	16 to 20	20 to 22	21 to 24	23 to 27	20 to 26	20 to 27
15 to 16	15 to 17	12 to 15	12 to 17	12 to 17	11 to 15	13 to 18
6 to 7	7 to 7½	7 to 7½	7¼ to 9	8⅛ to 9½	8¼ to 9¼	8½ to 9
7 to 7½	7 to 7½	7 to 7½	7½ to 7¾	7½ to 7¾	7 to 7¼	6 to 6¾
8	8	8	8 to 8¼	8 to 8¾	....	7 to 7¼
4⅞ to 7	4¾ to 6½	4¾ to 6½	4¼ to 6¼	4¼ to 6¼	4 to 6½	3¾ to 5
9¼ to 9¾	9⅜ to 9⅞	10 to 10½	10 to 10¾	9 to 9½	7½ to 8¼	7½ to 8
10 to 11⅛	10⅝ to 11⅝	11¼ to 12	11¼ to 12	10 to 11	8⅝ to 9½	8¼ to 9

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
CINCINNATI—Continued.					
Wool:					
Fleece-washed........lb.	$0 35 to $0 38	$0 35 to $0 38	$0 35 to $0 38	$0 35 to $0 38	$0 30 to $0 33
Tub-washed..........do.	33 to 39	33 to 39	33 to 39	33 to 39	28 to 32
Unwashed, clothing..do.	22 to 26	22 to 26	22 to 26	22 to 26	17 to 22
Unwashed, combing.do.	28 to 32	28 to 32	28 to 32	28 to 32	22 to 26
Pulled...............do.	27 to 30	27 to 30	27 to 30	27 to 30	23 to 27
CHICAGO.					
Flour:					
Choice winter extras.bbl.	6 75 to 7 25	6 50 to 7 00	6 50 to 7 00	6 50 to 6 75	6 00 to 6 50
Common to good extras..............bbl.	5 00 to 6 25	5 00 to 6 50	5 50 to 6 00	5 50 to 6 00	5 00 to 5 75
Choice spring extras.do.	5 50 to 6 00	4 50 to 6 00	5 50 to 6 00	5 50 to 6 25	5 25 to 6 25
Common to good extras..............bbl.	4 75 to 5 75	4 25 to 5 50	4 50 to 5 50	4 50 to 5 00	4 75 to 5 25
Patent spring........do.	7 00 to 9 00	6 00 to 8 50	6 50 to 8 00	6 50 to 8 50	6 50 to 8 50
Spring superfines....do.	3 00 to 4 00	2 50 to 3 25	3 00 to 3 50	2 75 to 4 00	2 75 to 4 00
Wheat:					
No. 1 spring........bush.	1 10 to 1 10½	1 05⅛ to 1 10	1 11 to 1 12½	..........1 13½	1 13 to 1 13½
No. 2 spring.........do..	1 08¾ to 1 09⅝	1 03½ to 1 04½	1 10 to 1 11½	1 10 to 1 12¼	1 12¼ to 1 13
No. 3 spring.........do..	1 01 to 1 02	97½ to 98	1 03 to 1 05	1 03½ to 1 04½	1 05¾ to 1 07
Rye No. 2.............do..	56..........	49½ to 50	55 to 57¼	..........58½	60
Barley No. 2..........do..	57½..........	49 to 50	45½ to 47	45½ to 47	47
Corn No. 2............do..	42½ to 43	39⅛ to 39½	43⅛ to 43⅝	42 to 42¼	40½ to 40⅞
Oats No. 2............do..	24½..........	23¾..........	24⅜ to 26¼	23¼..........	26¼ to 26⅞
Hay:					
Timothy.............ton.	8 50 to 10 00	8 00 to 9 50	8 00 to 10 00	9 00 to 10 00	8 50 to 10 00
Prairie...............do.	7 00 to 9 00	7 00 to 8 50	7 00 to 8 00	6 00 to 8 00	7 25 to 9 00
Beef:					
Mess.................bbl.	9 50 to 10 00	9 00 to 10 00	9 00 to 10 00	9 00 to 10 00	9 00 to 9 50
Extra mess...........do.	10 50 to 11 00	10 00 to 11 00	10 00 to 11 00	10 00 to 11 00	10 00 to 10 50
Hams.................do.	15 50 to 16 00	15 00 to 16 00	15 00 to 16 00	15 00 to 16 00	15 00 to 15 50
Pork:					
Mess.................bbl.	11 30..........	10 50 to 10 75	10 17½ to 10 30	9 35 to 9 40	8 40 to 8 45
Prime mess...........do.	10 50 to 11 00	9 00 to 10 00	9 00 to 10 00	9 00 to 9 50	8 00 to 8 25
Extra prime..........do.	9 50 to 10 00	8 25 to 8 50	7 75 to 8 00	7 75 to 8 00	7 25 to 7 50
Lard................cental.	7 50..........	..........7 30	7 20 to 7 22½	7 20 to 7 25	6 77½ to 6 80
Butter:					
Choice to fancy......lb.	25 to 31	30 to 36	30 to 37	28 to 33	18 to 23
Medium to good.....do.	14 to 20	14 to 26	15 to 24	15 to 22	15 to 20
Cheese:					
Good to choice factory.lb.	11½ to 12½	10½ to 12½	13 to 13½	12½ to 13½	9½ to 12
Poor to fair factory..do.	6 to 10½	4 to 10¼	5 to 12½	5 to 10½	3 to 9
Sugar, New Orleans, common to choice......lb.	6 to 8	6½ to 7¾	6½ to 7¼	6¾ to 8	....
Wool:					
Unwashed............lb.	22 to 28	20 to 27	20 to 27	18 to 25	18 to 25
Fleece-washed.......do.	35 to 40	38 to 40	37 to 40	33 to 38	33 to 38
Tub-washed..........do.	36 to 44	36 to 42	38 to 43	34 to 41	34 to 38
Colorado.............do.	18 to 30	....	18 to 29	17 to 26	17 to 25
SAINT LOUIS.					
Flour:					
Superfine............bbl.	3 50 to 4 50	3 25 to 4 00	4 00 to 4 05	4 10 to 4 25	3 55 to 4 00
Extra.................do.	4 75 to 5 60	4 50 to 5 25	4 50 to 5 35	4 30 to 5 00	4 20 to 5 00
Family and choice...do.	5 80 to 6 20	5 55 to 5 90	5 50 to 6 40	5 40 to 6 00	5 20 to 6 50
Wheat:					
White winter.....bush.	1 18 to 1 24	....	1 10 to 1 21	1 10 to 1 15	1 10 to 1 20
Red winter..........do..	1 11 to 1 18	1 05 to 1 13½	1 06 to 1 15	1 06 to 1 13½	1 06 to 1 17
Spring...............do..	1 08 to 1 10	1 01 to 1 04	1 01 to 1 07½	1 02 to 1 07	1 00 to 1 11
Corn..................do..	32¾ to 49	33 to 41⅞	32 to 43	32½ to 38½	35¼ to 39⅛
Rye..................bush.	52½ to 56½	49 to 50	51 to 54	52 to 57	55 to 60¾
Barley................do..	42 to 60	30 to 72½	38 to 60	45 to 57	30½ to 55
Oats..................do..	26½ to 28	23 to 35	25½ to 26½	25 to 38	24 to 35½
Hay:					
Timothy............ton.	9 25 to 11 00	9 50 to 11 50	10 00 to 12 50	10 00 to 12 00	9 75 to 10 50
Prairie...............do.	....	....	....	....	....
Beef:					
Mess.................bbl.	....	....	....	....	....
Extra family, mess..do.	13 00 to 13 25	13 00 to 13 25	13 00 to 13 25	13 00 to 13 25	12 50..........
Pork, mess............do.	11 37½ to 11 40	11 00 to 11 62½	10 60 to 10 75	9 70 to 10 25	8 75 to 9 00
Lard................cental.	7 00 to 8 00	6 75 to 8 00	7 00 to 9 50	6 92½ to 7 50	7 37½ to 9 25
Butter:					
Extra choice creamery, pound..............	35 to 38	35 to 40	38 to 40	35 to 38	28 to 30
Fair to choice dairy-tubs, pound..............	15 to 23	18 to 28	20 to 30	22 to 28	18 to 28
Cheese:					
New York and Ohio factory...............lb.	11½ to 12½	11½ to 12½	11½ to 14	11½ to 14	11½ to 13

PRODUCTS FOR 1878—Continued.

June.	July.	August.	September.	October.	November.	December.
$0 27 to $0 29	$0 27 to $0 29	$0 30 to $0 32	$0 28 to $0 32	$0 28 to $0 32	$0 28 to $0 32	$0 28 to $0 32
24 to 30	24 to 30	26 to 33	26 to 33	26 to 33	26 to 33	25 to 33
17 to 22	17 to 22	18 to 24	16 to 23	16 to 23	16 to 23	16 to 21
22 to 25	22 to 25	23 to 25	23 to 26	23 to 26	23 to 26	23 to 25
23 to 27	23 to 27	25 to 28	25 to 28	25 to 28	25 to 28	25 to 28
6 00 to 6 25	5 75 to 6 25	5 50 to 6 00	4 50 to 5 50	5 25 to 5 50	4 50 to 5 00	4 50 to 5 00
4 75 to 5 00	4 00 to 5 25	4 25 to 5 50	....	4 25 to 5 00	3 75 to 4 75	4 00 to 4 75
5 00 to 5 50	4 50 to 5 75	5 00 to 5 75	4 75 to 5 60	5 00 to 5 50	4 25 to 4 75	4 25 to 4 50
4 00 to 4 75	3 75 to 4 25	4 25 to 5 00	....	4 00 to 4 50	3 50 to 4 00	3 50 to 4 00
6 25 to 8 25	6 00 to 8 00	6 00 to 8 25	6 00 to 8 00	7 00 to 10 00	6 00 to 7 50	6 00 to 7 50
2 75 to 3 75	2 25 to 3 75	3 25 to 4 00	....	2 50 to 3 00	2 50 to 3 00	2 50 to 3 00
97 to 97⅞	89¼	97½ to 98	88½ to 89⅞	87½ to 89¼	81	....
97 to 97⅜	89¼	96½ to 97	88 to 88½	87 to 87½	80¾ to 8[illegible]½	83¼ to 83⅜
1 00 to 1 05	81	87	79½ to 80	73 to 75½	69 to 83	69 to 83½
50 to 52	47 to 49	45 to 50	44 to 48	41 to 45	40 to 45½	41 to 46½
48 to 49¾	48½ to 49	89 to 90½	1 09 to 1 14	1 09½ to 1 11	87 to 92	96 to 97
36 to 36¾	35⅞ to 36½	39¼ to 39¾	33½ to 33⅞	34¾ to 35¼	32½ to 34	28 to 31½
23½ to 23	24 to 24½	24 to 24½	18 to 22½	19¼ to 24½	19½ to 20¾	20 to 22½
8 00 to 9 50	8 00	9 00 to 9 50	8 00 to 8 50	6 50 to 8 50	6 10 to 8 50	7 50 to 8 00
5 00 to 8 00	....	7 00 to 8 00	6 50 to 7 00	5 50 to 7 00	6 50 to 7 00	6 50 to 7 00
9 00 to 9 50	9 00 to 9 50	9 00 to 9 50	8 50 to 9 00	8 00 to 8 50	7 50 to 8 00	7 75 to 8 00
10 00 to 10 50	10 00 to 10 50	10 00 to 10 50	9 50 to 10 00	8 50 to 9 00	8 50 to 8 75	8 50 to 8 75
15 00 to 16 00	21 00 to 21 50	21 00 to 21 50	18 00 to 18 50	17 00 to 17 50	14 00 to 14 25	13 50 to 14 00
8 60 to 8 90	9 30 to 9 35	9 92½ to 10 32½	8 50 to 9 05	7 85 to 8 02½	6 90 to 6 95	6 77 to 8 00
8 75 to 9 00	9 00 to 9 25	10 00 to 11 00	10 00 to 10 25	8 25 to 8 50	7 75 to 8 00	7 00 to 7 25
7 50 to 8 00	8 50 to 8 75	9 50 to 10 50	9 00 to 9 25	....	....	....
6 52½ to 6 72½	6 82 to 6 85	7 50 to 7 67½	6 60 to 6 90	6 15 to 6 27½	5 92½ to 5 95	5 67 to 5 70
17 to 17½	16 to 19	11 to 20	20 to 24	20 to 25	20 to 24	20 to 25
15 to 18	9 to 14	9 to 16	10 to 18	12 to 20	12 to 20	12 to 20
7	7 to 7½	6¾ to 7½	7 to 7½	7½ to 8½	8 to 9½	8 to 8½
4½ to 6½	3 to 5½	3 to 6¼	3 to 6½	3 to 7½	2 to 5	2 to 7½
....	....	....	....	....	....	6½ to 7¾
17 to 26	19 to 23	19 to 23	19 to 23	19 to 23	15 to 23	15 to 23
34 to 37	28 to 31	28 to 32	28 to 31	30 to 31	28 to 31	28 to 31
34 to 35	30 to 37	30 to 38	30 to 38	30 to 38	30 to 39	30 to 38
16 to 25	15 to 26	15 to 26	15 to 26	15 to 26	15 to 26	15 to 25
3 75 to 4 00	3 70 to 4 00	3 50 to 3 90	....	3 10 to 3 30	2 80 to 2 90	2 85 to 3 05
4 30 to 5 00	4 30 to 4 95	4 00 to 4 75	....	3 50 to 4 20	3 20 to 3 85	3 15 to 3 85
5 05 to 6 00	4 35 to 4 75	....	....	4 25 to 5 40	4 00 to 5 00	3 90 to 5 00
95 to 1 10	80 to 85	82 to 89	82 to 89	80 to 87	80 to 88	80 to 89
95 to 1 10	90 to 95	86½ to 89	86 to 89	82 to 87	80½ to 89	80½ to 91
....	....	....	....	....	73¼ to 73⅝	73½ to 74½
30½ to 41	31 to 43	35 to 43½	32 to 42	33 to 39	31⅞ to 32	28⅜ to 29⅝
50 to 52½	48 to 50	48 to 50	46 to 50	44 to 46	40¼ to 43	42¼ to 46
............70	....	44 to 50	50 to 65	40 to 98	40 to 1 00	42 to 90
23 to 32	22 to 24¾	23½ to 33	18 to 26	20¼ to 27	19 to 24	19¾ to 24½
7 50 to 11 00	8 50 to 9 50	8 00 to 10 75	8 50 to 9 50	8 00 to 9 25	8 00 to 10 00	7 75 to 9 25
....	....	....	....	....	....	....
....	....	....	....	....	....	....
12 50	12 50	12 50	12 50	....	....	....
9 37½ to 9 60	..........9 60	9 75 to 9 77½	....	8 70 to 8 75	7 50 to 8 25	7 65 to 8 25
6 30 to 7 50	..........7 25	6 37½ to 8 25	8 62½ to 8 75	7 75	6 00 to 6 75	5 40 to 6 20
15 to 20	18 to 22	22 to 24	23 to 27	24 to 27	23 to 27	25 to 28
10 to 15	10 to 15	12 to 17	12 to 19	14 to 22	14 to 20	14 to 20
9 to 11	6 to 7	7 to 8	7 to 8½	9 to 10	....	7½ to 8

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
SAINT LOUIS—Continued.					
Cheese—Continued:					
Western factory.....lb.	$0 11 to $0 12	$0 11 to $0 12	$0 11 to $0 12	$0 11 to $0 12	$0 09 to $0 11
Tobacco:					
Lugs............cental.	1 50 to 3 00	1 50 to 3 50	1 70 to 3 00	1 70 to 3 00	1 70 to 3 00
Common to medium leaf, cental................	4 00 to 6 50	4 00 to 6 50	4 00 to 7 00	4 00 to 7 00	4 00 to 7 00
Wool:					
Tub-washed..........lb.	28 to 41½	28 to 38	28 to 38	28 to 38	28 to 38
Unwashed combing..do.	25 to 31½	25 to 31	25 to 31	25 to 31	25 to 31
Texas..............do.	21 to 24	....	20 to 23	20 to 23	20 to 23
NEW ORLEANS.					
Flour:					
Superfine............bbl.	4 25..........	..........4 50	..........4 50	..........4 00	..........3 50
Extra...............do.	4 50 to 5 50	4 75 to 5 50	4 75 to 5 75	4 25 to 5 00	4 00 to 5 00
Choice to family.....do.	5 75 to 6 50	5 75 to 6 75	6 00 to 6 75	5 25 to 6 50	5 25 to 6 25
Wheat:					
No. 2 winter.......bush.	1 35..........	1 30 to 1 32	1 30 to 1 32	1 20 to 1 25	1 25..........
Spring..............do.	1 25..........	1 28 to 1 30	1 22..........	....	....
Corn.................do.	52 to 56	49 to 52	49 to 54	47 to 49	50 to 52
Oats.................do.	36 to 37	33 to 35	37½ to 39	36 to 37	34 to 35½
Hay:					
Prime...............ton.	15 00 to 16 00	15 00 to 16 00	15 00 to 16 00	..........16 00	13 00 to 14 50
Choice..............do.	19 00..........	18 00..........	17 00..........	17 50 to 18 50	15 00 to 18 50
Beef:					
Western mess......bbl.	12 00 to 12 50	11 00..........	10 00..........	11 00 to 11 25	10 50 to 11 00
Western mess, extra, barrel...............	14 00 to 14 50	..........14 00	..........13 00	....	12 00 to 13 00
Texas..............bbl.	....	....	....	....	....
Fulton Market....½ bbl.	9 85..........	9 75..........	9 50 to 9 75	9 75..........	9 75..........
Pork, mess...........bbl.	12 50 to 12 62½	11 75 to 12 00	10 00 to 11 75	10 60 to 11 00	9 25 to 9 50
Lard...............cental.	8 25 to 9 75	7 75 to 9 00	7 25 to 8 50	7 00 to 8 25	6 75 to 8 25
Butter:					
New York prime to choice..............lb.	24 to 31	26 to 32	26 to 33	26 to 32	26 to 33
Western prime to choice, pound................	18 to 30	12 to 28	13 to 20	16 to 20	16 to 20
Cheese:					
Western factory.....lb.	11¾ to 13	11 to 11¾	11 to 11¾	11½ to 12½	8 to 11
New York cream....do.	14 to 15	14 to 15	15 to 16	15 to 15½	15..........
Sugar:					
Fair to fully fair.....lb.	5¾ to 6¾	6 to 6¾	6⅛ to 6¾	6¼ to 7	6¼ to 7
Prime to steady prime, pound................	7 to 7½	7 to 7¼	7 to 7½	7¼ to 7¾	7¼ to 7½
Clarified white and yellow...............lb.	7¾ to 9	7¾ to 9⅛	7¾ to 9½	7¾ to 9	7¾ to 9¼
Cotton:					
Ordinary to good ordinary...............lb.	8⅜ to 9½	8⅛ to 8⅝	7⅛ to 8½	7⅜ to 8¼	7¾ to 8⅝
Low middling to good middling...........lb.	10⅛ to 11⅝	9⅞ to 10⅞	9⅜ to 11⅜	8⅞ to 10⅝	9¼ to 11⅛
Middling fair to good fair.................lb.	12 to 13½	11⅜ to 13¼	11¾ to 13½	11..........	11¼ to 11⅜
Good and fine.......do.	13¾ to 14	13¾ to 14	....	....	....
Tobacco:					
Lugs.................lb.	2 to 5	2½ to 4½	2½ to 4½	2½ to 4	3 to 4½
Leaf, low to medium.do.	5 to 7½	4¾ to 7	4¾ to 7	4½ to 8	5 to 8
Wool:					
Louisiana clear......do.	26 to 26½	....	Out of season.	21..........	18 to 19
Clear Lake..........do.	27½ to 28	....	Out of season.	23..........	19 to 21
SAN FRANCISCO.					
Flour:					
Superfine...........bbl.	5 00 to 5 25	4 75 to 5 00	4 75..........	4 75 to 5 50	5 00 to 5 25
Extra...............do.	5 50 to 5 75	5 50 to 5 75	5 50 to 5 75	5 75 to 6 25	5 50 to 6 00
Family and fancy....do.	6 50 to 7 25	6 50 to 7 00	6 50 to 7 00	6 25 to 6 50	6 50 to 6 75
Wheat:					
California........cental.	2 15 to 2 35	1 90 to 2 10	1 90 to 2 05	1 95 to 2 15	2 00 to 2 15
Oregon..............do.	2 15 to 2 35	1 90 to 2 05	1 90 to 2 00	1 95 to 2 10	2 00 to 2 10
Barley...............do.	1 60 to 1 75	1 45 to 1 65	1 20 to 1 45	1 40 to 1 45	1 15 to 1 40
Oats.................do.	1 60 to 2 00	1 60 to 2 05	1 40 to 1 65	1 45 to 1 65	1 20 to 1 65
Corn.................do.	1 55 to 1 75	1 55 to 1 75	1 60 to 2 00	1 50 to 1 90	2 10 to 2 25
Hay, State..........ton.	13 00 to 22 50	12 00 to 20 00	13 00 to 20 00	10 00 to 18 00	8 00 to 17 00
Pork:					
Mess................bbl.	22 00 to 23 50	22 00 to 22 50	19 00 to 20 00	19 00 to 20 00	18 75 to 19 00
Prime mess..........do.	18 50 to 19 00	18 50 to 19 00	16 00 to 17 00	16 00 to 17 00	17 00 to 17 75
Beef:					
Mess.................do.	8 50 to 10 00	8 50 to 10 00	9 00 to 11 00	10 00 to 12 00	12 00..........

* Market closed

PRODUCTS FOR 1878—Continued.

June.	July.	August.	September.	October.	November.	December.
$0 08 to $0 09	$0 05½ to $0 06	$0 06½ to $0 07	$0 07 to $0 08	$0 08½ to $0 09	....	$0 07 to $0 08
1 70 to 3 00	1 80 to 3 50	2 00 to 3 50	2 00 to 3 50	2 00 to 3 50	$1 75 to $3 00	1 75 to 3 00
3 25 to 7 00	3 25 to 7 00	3 50 to 7 00	4 25 to 7 75	4 00 to 6 50	3 25 to 5 75	3 25 to 5 75
28 to 37	30 to 37	30 to 37	25 to 35½	25 to 34	25 to 34	25 to 34
16 to 26	17 to 24	18 to 28	16 to 23½	16 to 23	16 to 23	16 to 23
....	....	....	21 to 24	....	....	....
........3 50	3 25........	3 00........	3 00........	3 00........	3 00 to 3 25	........3 25
4 00 to 5 25	3 50 to 4 50	3 25 to 4 00	3 25 to 4 50	3 25 to 4 50	3 25 to 4 50	3 75 to 4 50
5 25 to 5 75	4 25 to 5 75	4 75 to 5 50	4 75 to 6 00	4 50 to 5 50	4 50 to 5 25	4 62 to 5 50
1 05 to 1 15	85........	90 to 98	95 to 1 05	....	96........	........1 02
1 10........	....	....	....	....	....	....
53 to 56	42½........	44........	53........	48 to 50	54 to 57	43 to 47
34½ to 35	33 to 35	40 to 42	30 to 35	33 to 36	34 to 35	30 to 33
12 00 to 12 50	12 00........	13 00 to 14 00	........15 00	13 50........	........16 50	14 00........
15 00........	13 50........	14 00 to 15 00	17 00 to 18 00	16 00........	16 00 to 18 00	16 00 to 16 50
10 00........	9 00 to 13 00	9 00 to 13 00	9 50 to 13 50	11 00 to 13 50	........13 00	9 50........
12 00........	....	....	....	....	....	....
....	....	....	....	....	....	....
9 25........	....	....	8 25........	8 25........	8 25........	....
9 00 to 9 50	10 50 to 10 75	10 50 to 10 62	11 00 to 11 25	9 75 to 10 00	8 37½ to 9 25	8 00 to 8 75
6 75 to 8 00	7 25 to 8 25	7 50 to 8 87½	8 50 to 9 75	8 25 to 9 25	6 25 to 8 50	6 00 to 7 00
18 to 25	23 to 25	22 to 24	20 to 26	24 to 27	24 to 28	23 to 28
11 to 25	13 to 25	11 to 24	13 to 26	13 to 27	13 to 27	12 to 32
7 to 8½	7........	8 to 8½	6½ to 7	7½ to 9	8 to 9½	9 to 10
13½ to 14	11 to 12	11 to 12	11 to 12	11½ to 12	11¼ to 12	10½ to 11
6⅞ to 7½	6⅞ to 7½	7¾ to 8¼	7¾ to 8½	....	5¾ to 6¾	5½ to 6⅛
8........	7¾........	8⅛........	8½ to 9½	....	6⅞ to 7⅛	5¾ to 6¼
8½ to 9	8½ to 9½	9⅛ to 9½	9⅛ to 9½	8⅞ to 9	7¼ to 8⅜	6½ to 8¼
....	9¼ to 10½	9¾ to 10⅜	9½ to 10½	9 to 9⅝	8½ to 8⅝	7⅜ to 8
....	10¼ to 11⅛	10⅝ to 12	10⅝ to 11½	9⅞ to 10¾	9⅝ to 10⅛	8½ to 9⅛
11¼ to 11⅜	....	12⅛ to 12¼	....	........10¾	10⅜ to 10⅝	10 to 10¼
....	....	....	....	....	....	....
3 to 4	3 to 3½	3 to 3½	2¼ to 3½	2¼ to 3¼	2¼ to 3	2 to 3¾
5 to 8	5¾ to 8	4½ to 8	4½ to 7	4¼ to 7	4 to 6½	4 to 6⅛
19 to 20	20 to 22½	22½........	22 to 22½	21 to 22	(*)	....
20 to 22	23 to 24	23½........	23........	22 to 22½	(*)	....
4 75 to 5 00	4 25 to 4 50	4 25 to 4 35	4 40 to 4 50	4 25 to 4 50	4 00 to 4 25	4 00 to 4 25
5 00 to 5 50	4 75........	4 50 to 4 75	4 60 to 4 75	4 50 to 4 75	4 30 to 4 50	4 30 to 4 50
5 75 to 6 25	5 00 to 5 25	5 00 to 5 50	5 00 to 6 00	5 00 to 5 75	5 00 to 5 50	5 00 to 5 50
1 75 to 1 85	1 65 to 1 80	1 65 to 1 75	1 37½ to 1 80	1 25 to 1 70	1 25 to 1 80	1 25 to 1 80
1 67½ to 1 80	1 60 to 1 65	1 60 to 1 65	1 60 to 1 75	1 60 to 1 65	1 50 to 1 75	1 50 to 1 75
1 15 to 1 25	1 05 to 1 15	1 35 to 1 40	90 to 1 30	90 to 1 25	85 to 1 25	85 to 1 30
1 35 to 1 55	1 30 to 1 50	1 30 to 1 55	1 35 to 1 65	1 35 to 1 65	1 35 to 1 45	1 25 to 1 65
2 05 to 2 25	1 95 to 2 25	1 80 to 2 50	1 75........	1 10 to 1 15	1 10 to 1 15	1 00 to 1 05
6 50 to 15 50	7 50 to 13 50	7 00 to 14 00	7 00 to 14 00	7 00 to 14 00	7 50 to 14 50	7 50 to 13 50
18 75 to 19 00	18 00 to 18 50	18 00 to 18 50	18 00 to 18 50	18 00 to 18 50	18 00 to 18 50	18 00 to 18 50
16 00 to 17 00	16 00 to 17 00	16 00 to 17 00	16 00 to 17 50	16 00 to 16 50	15 00 to 15 50	15 00 to 15 50
10 00 to 11 00	11 00 to 12 00	10 00 to 11 50	10 00 to 10 50	10 00 to 10 50	10 00 to 10 50	10 00 to 10 50

for the year.

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
SAN FRANCISCO—Cont'd.					
Beef—Continued:					
Family mess ....½ bl.	$8 00 to $8 50	$8 00 to $8 50	$8 00 to $8 50	$8 00 to $8 50	$8 00 to $8 25
Lard ....lb.	10½ to 13	10½ to 13	10 to 12	10 to 12	10 to 12
Butter:					
Overland ....do.	18 to 25	18 to 25	15 to 18	15 to 16	15 to 16
California ....do.	25 to 35	25 to 32½	25 to 30	20 to 22½	20 to 25
Oregon ....do.	18 to 20	18 to 20	15 to 18	15 to 18	15 to 18
Cheese ....do.	19 to 25	19 to 25	18 to 20	16 to 18	14 to 18
Wool:					
Native ....do.	10 to 15	10 to 15	10 to 15	10 to 15	12 to 16
California ....do.	15 to 20	15 to 20	15 to 20	15 to 20	18 to 25
Oregon ....do.	18 to 20	18 to 20	20 to 25	20 to 25	20 to 26

LIVE-STOCK

	January.	February.	March.	April.	May.
NEW YORK.					
Cattle:					
Extra beeves ....cental.	11 50 to 12 00	11 50 to 12 00	10 50 to 10 75	10 25 to 10 75	10 25 to 10 50
Good to prime.......do..	10 50 to 11 25	10 50 to 10 75	9 00 to 10 25	9 25 to 10 00	9 75 to 10 00
Common to fair.....do..	9 00 to 10 00	9 00 to 9 50	8 00 to 8 75	8 25 to 9 00	8 00 to 8 75
Poor to common....do..	7 25 to 8 75	8 00 to 8 50	....	7 50 to 8 25	....
Texas and Cherokee.do..	.... 9 25	....	....	8 00 to 9 00	8 00 to 8 25
Milch cows ....head.	40 00 to 65 00	40 00 to 70 00	40 00 to 70 00	35 00 to 75 00	35 00 to 60 00
Veal calves.......cental.	3 00 to 8 50	6 50 to 8 50	8 00 to 8 50	5 25 to 6 75	4 00 to 6 00
Sheep ....do..	4 50 to 6 50	4 25 to 6 25	5 25 to 6 75	4 75 to 6 75	4 25 to 5 75
Swine ....do..	4 50 to 4 80	4 40 to 4 50	4 20 to 4 40	4 50 to 5 50	Nominal.
PHILADELPHIA.					
Cattle:					
Choice beeves ...cental.	6 25 to 6 62½	6 00 to 6 50	6 00 to 6 25	6 25 to 6 50	5 87½ to 6 12½
Fair to good.........do..	5 62½ to 6 12½	5 25 to 5 87½	4 87½ to 5 87½	5 25 to 6 12½	4 87½ to 5 75
Common ....do..	3 00 to 5 00	3 75 to 4 25	3 62½ to 4 75	4 00 to 5 00	2 50 to 4 75
Sheep ....do..	3 50 to 6 00	3 75 to 6 25	4 00 to 6 25	5 00 to 6 75	3 00 to 6 25
Swine, best corn-fed ..do..	6 00 to 6 25	5 75 to 6 25	6 25 to 6 50	6 00 to 6 25	5 62½ to 6 12½
Common ....do..	5 00 to 5 50	....	5 50 to 6 00	5 00 to 5 50	5 00 to 5 16
BALTIMORE.					
Cattle:					
Best beeves.......cental.	5 25 to 6 25	4 87 to 5 75	4 75 to 6 00	5 00 to 5 50	5 25 to 5 62
First quality ....do..	4 50 to 5 25	4 00 to 4 75	3 75 to 4 75	4 00 to 5 00	4 50 to 5 25
Medium or good fair quality ....cental.	3 50 to 4 50	3 00 to 4 00	3 25 to 3 75	3 37 to 4 00	3 75 to 4 25
Ordinary ....do..	3 00 to 3 50	2 50 to 3 00	3 00 to 3 25	3 00 to 3 25	3 00 to 3 62
Most of the sales...do..	4 25 to 5 00	3 75 to 4 62	3 75 to 5 00	4 25 to 5 00	4 25 to 5 37
Milch cows ....head.	30 00 to 55 00	25 00 to 60 00	25 00 to 55 00	20 00 to 50 00	25 00 to 50 00
Sheep ....cental.	4 00 to 6 00	4 00 to 5 75	3 50 to 6 25	4 00 to 6 25	4 00 to 5 00
Swine ....do..	5 75 to 6 25	5 25 to 6 25	5 25 to 6 25	5 25 to 6 00	4 75 to 5 50
CINCINNATI.					
Cattle:					
Fair to good shipping steers...........cental.	4 25 to 4 75	4 50 to 5 00	4 25 to 4 75	4 25 to 4 75	4 25 to 4 75
Common to choice butchers' grades.....cental.	2 00 to 4 25	2 25 to 4 75	3 50 to 4 35	2 00 to 4 65	2 75 to 4 60
Cows, heifers, &c ...do..	3 00 to 4 25	2 75 to 4 50	3 50 to 4 00	3 00 to 4 40	3 00 to 4 40
Sheep ....do..	2 50 to 4 50	2 50 to 4 75	3 00 to 5 00	3 00 to 5 50	3 50 to 6 50
Swine ....do..	3 50 to 4 10	3 40 to 4 10	3 00 to 3 85	3 15 to 3 90	2 60 to 3 35
CHICAGO.					
Cattle:					
Extra beeves ....cental.	5 15 to 5 40	5 00 to 5 25	4 75 to 5 15	5 00 to 5 30	5 00 to 5 30
Choice beeves ....do..	4 50 to 4 90	4 62½ to 4 75	4 25 to 4 50	4 50 to 4 75	4 50 to 4 75
Good beeves..........do..	4 00 to 4 40	4 25 to 4 50	3 65 to 4 00	4 00 to 4 40	4 10 to 4 40
Medium grades......do..	3 50 to 3 85	3 75 to 4 00	3 40 to 3 65	3 60 to 3 90	3 85 to 4 00
Inferior natives ....do..	1 75 to 3 25	1 50 to 3 50	1 75 to 3 00	2 00 to 3 00	2 00 to 3 25
Texas ....do..	....	....	....	....	....
Veal calves..........do..	3 00 to 5 75	4 00 to 5 00	3 00 to 5 00	3 00 to 5 00	2 75 to 5 00
Sheep ....do..	3 00 to 5 00	2 25 to 4 75	3 25 to 5 25	3 25 to 4 75	3 00 to 4 60
Swine ....do..	3 25 to 4 30	3 00 to 4 10	2 50 to 4 07½	3 50 to 4 10	3 00 to 4 00
SAINT LOUIS.					
Cattle:					
Good to choice natives, cental	4 90 to 5 12	4 50 to 5 12½	4 65 to 5 00	4 25 to 5 00	4 15 to 5 00
Fair to good natives, cental	3 90 to 4 25	3 75 to 4 05	3 70 to 4 35	4 00 to 4 25	3 75 to 4 10

PRODUCTS FOR 1878—Continued.

June.	July.	August.	September.	October.	November.	December.
$8 00 to $8 25	$8 00 to $8 25	$6 50..........	$8 00 to $8 50	$8 00 to $8 50	$8 00 to $8 50	$8 00 to $8 50
10 to 12	10 to 12½	10 to $0 12½	10 to 12½	10 to 12	10½ to 11¾	9½ to 11
15 to 16	15 to 16	15 to 16	15 to 16	15 to 16	15 to 16	15 to 16
20 to 23	20 to 23	20 to 24	20 to 32½	20 to 35	20 to 40	20 to 35
15 to 18	15 to 18	15 to 16	15 to 16	15 to 16	15 to 16	15 to 16
10 to 16	10 to 16	10 to 16	10 to 16	10 to 16	10 to 16	10 to 16
10 to 15	10 to 15	10 to 15	10 to 15	8 to 15	8 to 15	8 to 15
18 to 25	18 to 24	18 to 25	18 to 25	18 to 22	18 to 20	16 to 18
20 to 25	20 to 24	20 to 25	20 to 25	20 to 22	20 to 20	15 to 18

MARKETS.

10 25 to 11 25	9 75 to 10 00	9 75 to 10 00	.... 10 50	7 75 to 10 25	9 50 to 9 75	9 75 to 10 75
10 00 to 10 50	8 75 to 9 50	8 75 to 9 50	7 25 to 10 25	....	7 00 to 9 25	8 00 to 9 50
8 00 to 8 50	8 00 to 8 50	8 25 to 8 50	8 00 to 8 75	....	....	....
....	6 50 to 8 00	7 25 to 8 25	....	....	....	....
7 50 to 8 25	6 50 to 8 50	7 00 to 8 50	7 50 to 8 00	5 50 to 7 75	7 00 to 7 25	....
40 00 to 60 00	35 00 to 65 00	30 00 to 60 00	40 00 to 60 00	45 00 to 65 00	....	40 00 to 60 00
3 00 to 6 25	4 50 to 6 50	5 50 to 7 00	3 00 to 7 00	2 50 to 7 00	2 25 to 6 50	2 75 to 7 00
3 75 to 5 75	3 75 to 4 75	3 75 to 4 80	3 50 to 5 50	4 00 to 5 50	3 25 to 4 75	4 00 to 5 50
....	5 50 to 5 87	4 70	4 37½ to 4 50	3 75 to 4 35	3 20 to 3 30	2 90 to 3 15
5 75 to 6 00	5 25 to 5 62½	5 50 to 6 00	5 62½ to 5 87½	5 50 to 5 75	5 00 to 5 25	5 37 to 5 50
5 25 to 5 50	4 12½ to 5 12½	5 00 to 5 25	5 00 to 5 50	5 00 to 5 50	4 00 to 4 87	4 25 to 5 25
4 00 to 5 00	3 50 to 4 00	4 00 to 4 50	3 50 to 4 87½	3 50 to 4 87½	3 00 to 3 87	3 00 to 4 12
3 25 to 5 00	2 50 to 4 50	2 50 to 4 75	3 00 to 4 75	3 50 to 5 00	3 00 to 4 75	3 50 to 4 75
5 25 to 5 50	6 00 to 7 00	6 00 to 6 75	6 75 to 7 50	6 50 to 6 75	5 50	4 25 to 4 50
4 50 to 4 75	6 00	6 00	6 00 to 6 50	5 50 to 6 25	4 25 to 5 25	3 50 to 4 12
5 12 to 5 75	4 87 to 5 60	5 00 to 5 50	4 75 to 5 12	4 87 to 5 20	4 50 to 4 75	4 62 to 5 00
4 62 to 5 12	4 62 to 4 87	4 62 to 4 87	4 25 to 4 50	4 37 to 4 62	3 00 to 4 00	3 87 to 4 62
4 00 to 4 62	3 62 to 4 62	3 37 to 4 37	3 37 to 4 25	3 50 to 4 37	2 75 to 3 25	3 37 to 3 87
2 75 to 3 75	3 00 to 3 62	3 00 to 3 25	2 25 to 3 25	3 00 to 3 50	2 12 to 2 37	2 50 to 3 25
5 00 to 5 37	4 37 to 5 25	4 00 to 4 75	3 62 to 4 25	3 87 to 4 50	2 75 to 3 62	3 50 to 4 25
25 00 to 50 00	25 00 to 45 00	20 00 to 45 00	25 00 to 45 00	25 00 to 50 00	20 00 to 50 00	20 00 to 50 00
3 50 to 5 12½	3 00 to 4 50	3 50 to 4 37	3 25 to 4 50	3 50 to 4 75	3 00 to 3 50	3 50 to 4 50
4 50 to 4 75	5 50 to 6 50	6 00 to 6 75	5 25 to 6 37½	5 50 to 6 37½	4 00 to 4 50	3 75 to 4 50
4 25 to 4 75	4 00 to 4 65	4 00 to 4 75	4 25 to 4 85	4 00 to 4 75	3 25 to 4 25	3 75 to 4 25
1 75 to 4 25	2 50 to 4 35	1 50 to 4 00	1 50 to 4 25	1 50 to 3 75	1 50 to 3 65	1 50 to 4 00
3 25 to 4 00	3 25 to 4 25	2 50 to 3 50	3 25 to 4 00	3 00 to 3 50	2 75 to 3 50	3 00 to 3 75
2 50 to 4 25	2 25 to 3 75	2 25 to 4 50	2 25 to 4 50	2 25 to 4 25	2 25 to 4 25	2 25 to 4 25
2 80 to 3 50	3 15 to 4 45	3 00 to 4 85	2 50 to 4 15	2 50 to 3 75	2 25 to 2 85	2 15 to 2 80
5 00 to 5 30	5 00 to 5 25	4 90 to 5 25	5 00 to 5 40	4 85 to 5 25	4 50 to 4 75	4 50 to 4 80
4 50 to 4 75	4 50 to 4 85	4 25 to 4 65	4 40 to 4 65	4 25 to 4 50	4 00 to 4 25	4 00 to 4 25
4 10 to 4 40	4 00 to 4 40	3 50 to 4 10	4 00 to 4 30	3 50 to 4 00	3 25 to 3 80	3 50 to 3 90
3 85 to 4 00	3 75 to 4 00	3 25 to 3 40	3 50 to 3 85	3 25 to 3 40	3 00 to 3 25	3 10 to 3 40
2 00 to 3 40	2 00 to 3 50	1 90 to 2 00	3 00 to 3 25	1 75 to 2 00	1 60 to 2 00	1 75 to 2 00
....	2 00 to 3 35	2 25 to 3 00	2 70 to 3 15	2 25 to 2 80	2 00 to 4 00	....
2 75 to 5 00	2 75 to 4 50	2 75 to 4 45	3 00 to 4 75	3 00 to 4 75	2 75 to 4 50	2 75 to 4 50
2 75 to 4 25	2 50 to 4 00	2 50 to 5 00	3 00 to 5 00	3 00 to 4 50	2 25 to 3 25	2 50 to 3 75
3 50 to 4 10	3 95 to 4 15	3 25 to 4 50	3 90 to 4 60	3 15 to 3 75	2 25 to 3 30	2 65 to 2 95
4 60 to 5 25	4 75 to 5 00	4 75 to 5 00	4 80 to 5 10	4 75 to 5 00	4 50 to 4 65	4 20 to 4 65
4 65 to 4 80	4 50 to 4 60	4 50 to 4 60	4 60 to 4 75	4 50 to 4 65	4 20 to 4 40	3 85 to 4 00

LIVE-STOCK MAR

Products.	January.	February.	March.	April.	May.
SAINT LOUIS—Continued.					
Cattle—Continued:					
Good to choice butchers' steers .... cental.	$3 85 to $4 15	$3 75 to $4 00	$3 50 to $3 75	$3 50 to $3 75	$3 80 to $4 25
Inferior native grades, cental	2 00 to 3 75	1 70 to 3 50	2 75 to 3 60	3 00 to 3 45	2 75 to 3 70
Texas and Cherokee, cental	2 25 to 3 60	2 75 to 4 25	3 25 to 3 85	3 30 to 4 00	3 37½ to 4 25
Sheep .... cental.	1 25 to 4 35	2 50 to 4 50	3 00 to 5 00	2 00 to 5 00	2 00 to 5 25
Swine .... do..	3 25 to 4 15	3 40 to 4 00	3 45 to 4 00	3 20 to 3 60	2 90 to 3 10
Horses:					
Plugs .... head.	15 00 to 35 00	20 00 to 35 00	20 00 to 35 00	20 00 to 35 00	20 00 to 35 00
Southern horses .... do..	35 00 to 70 00	30 00 to 75 00	40 00 to 65 00	35 00 to 65 00	35 00 to 65 00
Streeters .... do..	70 00 to 85 00	75 00 to 85 00	70 00 to 85 00	70 00 to 85 00	70 00 to 90 00
Heavy draft .... do..	80 00 to 160 00	80 00 to 160 00	80 00 to 160 00	80 00 to 160 00	80 00 to 160 00
Saddle horses .... do..	50 00 to 100 00	50 00 to 100 00	60 00 to 90 00	60 00 to 85 00	60 00 to 90 00
Extra drivers ...... do..	150 00 to 160 00	150 00 to 160 00	150 00 to 160 00	150 00 to 160 00	120 00 to 160 00
Good matches ...... do..	250 00 to 300 00	250 00 to 300 00	250 00 to 300 00	250 00 to 300 00	240 00 to 275 00
Mules:					
14 to 15 hands high . do..	50 00 to 75 00	50 00 to 75 00	45 00 to 75 00	40 00 to 75 00	40 00 to 70 00
15 to 16 hands high . do..	75 00 to 130 00	80 00 to 130 00	75 00 to 100 00	75 00 to 100 00	75 00 to 110 00
16 to 16½ hands high . do..	125 00 to 140 00	125 00 to 140 00	125 00 to 140 00	125 00 to 140 00	135 00 to 150 00
NEW ORLEANS.					
Cattle:					
Corn-fed beeves .. cental.	2 50 to 5 00	2 50 to 5 00	2 50 to 5 00	2 50 to 5 00	2 50 to 4 50
Choice Texas beeves, head	30 00 to 35 00	30 00 to 35 00	30 00	30 00	30 00 ....
Texas, 1st quality . head.	20 00 to 30 00	20 00 to 30 00	25 00	25 00	25 00 ....
Texas, 2d quality ... do..	10 00 to 15 00	10 00 to 15 00	15 00 to 20 00	15 00 to 20 00	15 00 to 20 00
Milch cows .... do..	50 00 to 160 00	40 00 to 90 00	40 00 to 90 00	40 00 to 90 00	40 00 to 90 00
Calves .... do..	6 00 to 10 00	6 00 to 8 00	6 00 to 8 00	7 00 to 9 00	7 00 to 9 00
Sheep .... do..	2 00 to 4 00	2 00 to 5 00	2 00 to 5 00	2 00 to 5 00	2 00 to 4 00
Swine .... do..	3 50 to 5 00	3 00 to 4 50	3 00 to 4 50	3 00 to 4 00	3 50 to 5 00
Horses:					
Common .... do..	25 00 to 65 00	25 00 to 65 00	25 00 to 65 00	25 00 to 65 00	25 00 to 65 00
Plugs .... do..	85 00 to 135 00	85 00 to 135 00	85 00 to 135 00	85 00 to 135 00	85 00 to 135 00
Good combined ..... do..	135 00 to 185 00	135 00 to 185 00	135 00 to 185 00	135 00 to 185 00	135 00 to 185 00
Mules:					
First class .... do..	175 00 to 210 00	175 00 to 210 00	175 00 to 210 00	175 00 to 210 00	175 00 to 210 00
For sugar plantation, head	160 00 to 185 00	160 00 to 185 00	160 00 to 185 00	160 00 to 185 00	160 00 to 185 00
For city use ...... head	160 00 to 210 00	160 00 to 210 00	160 00 to 210 00	160 00 to 210 00	160 00 to 210 00
For rice culture, small, head	85 00 to 90 00	85 00 to 90 00	85 00 to 90 00	85 00 to 90 00	85 00 to 90 00

KETS—Continued.

June.	July.	August.	September.	October.	November.	December.
$3 60 to $4 00	$3 50 to $4 25	$3 50 to $4 00	$3 50 to $4 25	$3 00 to $3 75	$3 00 to $3 50	$2 85 to $3 40
3 00 to 3 55	2 75 to 3 40	2 75 to 3 40	2 25 to 3 65	2 25 to 3 40	2 25 to 3 25	2 25 to 3 37
2 00 to 3 25	2 00 to 3 25	2 30 to 3 20	2 50 to 3 20	2 50 to 3 25	2 00 to 3 10	2 00 to 3 10
2 00 to 3 62½	2 00 to 3 75	2 00 to 3 75	2 00 to 3 75	2 00 to 3 85	2 00 to 3 75	2 00 to 3 40
2 60 to 3 36	3 75 to 4 35	4 07½ to 4 40	3 00 to 4 40	2 80 to 3 50	3 00 to 3 35	2 20 to 2 80
20 00 to 35 00	20 00 to 35 00	20 00 to 35 00	20 00 to 35 00	15 00 to 30 00	15 00 to 30 00	15 00 to 30 00
40 00 to 60 00	40 00 to 60 00	40 00 to 60 00	40 00 to 60 00	35 00 to 55 00	35 00 to 55 00	35 00 to 55 00
70 00 to 86 00	70 00 to 86 00	70 00 to 86 00	70 00 to 86 00	70 00 to 86 00	70 00 to 86 00	70 00 to 86 00
80 00 to 160 00	80 00 to 160 00	80 00 to 160 00	80 00 to 160 00	80 00 to 160 00	80 00 to 160 00	80 00 to 160 00
60 00 to 85 00	60 00 to 85 00	60 00 to 85 00	60 00 to 85 00	60 00 to 85 00	60 00 to 85 00	60 00 to 85 00
150 00 to 160 00	150 00 to 160 00	150 00 to 160 00	150 00 to 160 00	150 00 to 160 00	150 00 to 160 00	150 00 to 160 00
250 00 to 300 00	250 00 to 300 00	250 00 to 300 00	250 00 to 300 00	250 00 to 300 00	250 00 to 300 00	250 00 to 300 00
40 00 to 75 00	40 00 to 75 00	40 00 to 75 00	40 00 to 75 00	35 00 to 75 00	35 00 to 75 00	35 00 to 75 00
75 00 to 100 00	75 00 to 100 00	75 00 to 100 00	70 00 to 100 00	75 00 to 120 00	75 00 to 120 00	75 00 to 120 00
125 00 to 140 00	125 00 to 140 00	125 00 to 140 00	125 00 to 140 00	125 00 to 140 00	125 00 to 140 00	125 00 to 140 00
2 50 to 4 50	2 50 to 4 50	.... 4 00	....	....	.... 4 00	2 00 to 4 50
30 00	30 00 to 35 00	....	....	....	....	....
25 00	20 00 to 25 00	35 00 to 40 00	35 00 to 40 00	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00
15 00 to 20 00	15 00 to 20 00	25 00 to 30 00	25 00 to 30 00	15 00 to 25 00	15 00 to 25 00	15 00 to 25 00
40 00 to 90 00	40 00 to 70 00	30 00 to 70 00	30 00 to 70 00	30 00 to 70 00	30 00 to 90 00	30 00 to 90 00
7 00 to 9 00	6 00 to 8 00	6 00 to 8 00	6 00 to 8 00	6 00 to 8 00	6 00 to 8 00	6 00 to 8 00
2 00 to 4 00	2 00 to 4 00	2 00 to 3 50	2 00 to 3 50	2 00 to 3 50	2 00 to 3 00	2 00 to 4 00
3 00 to 4 50	3 00 to 4 50	3 00 to 4 50	3 00 to 4 50	3 00 to 4 50	2 50 to 4 00	2 00 to 3 50
25 00 to 65 00	25 00 to 65 00	25 00 to 65 00	25 00 to 65 00	25 00 to 65 00	50 00 to 100 00	50 00 to 100 00
85 00 to 135 00	85 00 to 135 00	85 00 to 135 00	85 00 to 135 00	85 00 to 135 00	....	....
135 00 to 185 00	135 00 to 185 00	135 00 to 185 00	135 00 to 185 00	135 00 to 185 00	....	....
165 00 to 210 00	175 00 to 210 00	175 00 to 210 00	175 00 to 210 00	175 00 to 210 00	175 00 to 225 00	175 00 to 225 00
160 00 to 185 00	160 00 to 185 00	160 00 to 185 00	160 00 to 185 00	160 00 to 185 00	150 00 to 200 00	....
160 00 to 210 00	160 00 to 210 00	160 00 to 210 00	160 00 to 210 00	160 00 to 210 00	175 00 to 225 00	175 00 to 225 00
85 00 to 90 00	85 00 to 90 00	85 00 to 90 00	85 00 to 90 00	25 00 to 90 00	125 00 to 150 00	100 00 to 150 00

PORK PACKING.

The following statistics have been compiled from the annual reports of the Cincinnati Price Current. The "packing year" consists of a "summer season" from March 1 to November 1, and of a winter season from November 1 to March 1. Summer packing has risen to importance during the last few years, and presents some points of advantage over winter packing. In warm weather feed can be utilized to greater advantage in fattening hogs. The scarcity of ice during the last summer season somewhat restricted operations, but every year better provision is being made to meet this difficulty. The great pork region of our country is

IN THE WEST.

SUMMER PACKING.—The summer-packing season of 1878 opened with an increased supply of hogs at depressed prices, the general average cost being at least 50 cents per cental below the average of the previous winter season. The numbers packed, weight per head, and the yield of lard during the last three summer seasons, were as follows:

Season.	Numbers.	Aggregate net weight.	Average net weight per head.	Aggregate yield of lard.	Average yield of lard per head.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1876	2,357,866	424,879,300	184.10	70,040,980	30.35
1877	2,543,120	484,553,471	190.57	85,364,176	33.56
1878	3,378,044	631,807,730	187.03	113,949,500	33.73

The numbers packed at the six leading cities, Chicago, Cincinnati, Saint Louis, Milwaukee, Louisville, and Indianapolis, together with other prominent points, during the last three years, were as follows:

Packing points.	1876.	1877.	1878.
Chicago	1,315,402	1,508,026	2,017,841
Cincinnati	121,173	134,416	154,517
Saint Louis	131,158	148,277	142,000
Milwaukee	60,827	54,785	107,053
Louisville	9,500	19,800	25,000
Indianapolis	283,621	204,264	312,224
Total for the six cities	1,921,681	2,069,568	2,758,635
Cleveland, Ohio	187,392	146,048	229,385
Cedar Rapids, Iowa	105,580	110,130	195,200
Kansas City, Mo	66,754	77,821	99,517
Des Moines, Iowa	28,609	34,503	12,027
Detroit, Mich	24,000	34,028	30,302
Other points	23,850	71,022	52,978
Grand total	2,357,866	2,543,120	3,378,044

These six cities are the great centers of winter operations, packing over 70 per cent. of the winter hogs of the West. Their proportion of the summer packing is still greater—over 81 per cent.

WINTER PACKING.—The great bulk of the pork packing of the West, as well as of other parts of the country, is done during the four months of the "winter season," or from November, to March inclusive. The operations of the last season show an increase of over 13 per cent. over the enormous aggregates of the winter previous. This enlargement, in the face of immense losses sustained by the packing interest as the result of former seasons, could only have been secured by a marked reduction in prices. At the opening of the season it had become evident that the country was teeming with hogs fit for packing. The enormous corn crops of the last four years had made hog-feed abundant and cheap. The diffusion of improved breeds had also greatly reduced the time

necessary for the production of marketable hogs; hence the vast amount of material which inundated the market. There are indications that the farmers in several different parts of the country have marketed their stock more closely than is consistent with prudence, even selling animals not sufficiently mature for packing purposes. It is apprehended in some quarters that this policy will limit the supply of the ensuing summer season. Prices at the opening of the season at $3.00 @ $3.25 gross. But it soon became evident that the market would not bear even this reduced price, and hence quotations gradually fell to $2.50 @ $2.75. The falling prices seemed only to stimulate the anxiety of farmers to realize what they could upon their stock, until the market began to assume the appearance of a panic. The market was overstocked with hogs, many of which were of immature growth, and scarcely fit for packing.

The following table shows the comparative receipts of the last three winter seasons:

States.	1876-'77.		1877-'78.		1878-'79.	
	Number packed.	Per cent. of the whole.	Number packed.	Per cent. of the whole.	Number packed.	Per cent. of the whole.
Ohio	813, 709	15. 93	934, 132	14. 36	932, 878	12. 47
Indiana	530, 286	10. 37	496, 025	7. 63	682, 321	9. 12
Illinois	1, 905, 219	37. 28	2, 714, 748	41. 73	3, 214, 896	42. 97
Iowa	419, 442	8. 21	486, 850	7. 49	569, 703	7. 59
Missouri	644, 699	12. 61	804, 614	12. 37	965, 839	12. 91
Kansas	31, 775	. 62	41, 470	. 64	132, 346	1. 78
Nebraska	46, 190	. 90	56, 000	. 86	80, 658	1. 08
Minnesota	24, 235	. 47	23, 700	. 36	18, 450	. 25
Wisconsin	266, 861	5. 23	412, 614	6. 34	472, 108	6. 34
Michigan	88, 689	1. 73	120, 095	1. 84	132, 976	1. 77
Kentucky	255, 986	5. 01	318, 301	4. 89	212, 412	2. 84
Tennessee	50, 770	. 99	66, 897	1. 03	40, 561	. 54
Miscellaneous	23, 447	. 65	30, 000	. 46	25, 500	. 34
Total	5, 101, 308	100. 00	6, 505, 446	100. 00	7, 480, 648	100. 00

From the above it appears that Illinois is rapidly increasing her proportion, having packed, during the past year, nearly half of the animals marketed in the West. This is due to the fact that Chicago, which packed over nine-tenths of the number of hogs reported for the State, has greatly enlarged her facilities for the work and extended her market relations so as to attract a vast number of hogs from neighboring States.

The average weight per head, the average weight of lard, and the average cost per cental in the different States is shown in the following table:

States.	1876-'77.			1877-'78.			1878-'79.		
	Average net weight per head.	Average weight of lard.	Average cost per cental.	Average net weight per head.	Average weight of lard.	Average cost per cental.	Average net weight per head.	Average weight of lard.	Average cost per cental.
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	
Ohio	218. 15	36. 49	$7. 20	223. 85	39. 00	$5. 15	210. 47	35. 09	$3. 63
Indiana	199. 41	29. 69	7. 02	214. 32	34. 42	4. 93	193. 80	29. 09	3. 42
Illinois	218. 09	35. 19	7. 42	229. 57	39. 73	5. 10	225. 71	44. 00	3. 74
Iowa	207. 75	33. 26	6. 82	220. 53	37. 70	4. 48	211. 98	37. 73	3. 14
Missouri	213. 93	33. 88	7. 05	219. 74	39. 12	4. 82	213. 32	40. 83	3. 40
Kansas	240. 41	37. 16	6. 61	267. 48	42. 20	4. 36	221. 14	39. 46	3. 29
Nebraska	220. 39	38. 10	6. 78	232. 28	47. 71	4. 40	231. 02	44. 29	3. 14
Minnesota	249. 94	29. 30	6. 49	261. 10	44. 11	4. 42	263. 09	30. 09	2. 97
Wisconsin	226. 67	30. 73	7. 11	236. 51	39. 14	4. 83	220. 81	36. 22	3. 47
Michigan	232. 35	32. 90	6. 92	234. 88	36. 94	4. 83	210. 69	32. 60	3. 37
Kentucky	222. 52	33. 10	6. 99	223. 72	34. 67	5. 35	210. 11	32. 29	3. 36
Tennessee	208. 04	31. 48	6. 74	208. 65	31. 58	5. 03	209. 49	32. 95	3. 17
Miscellaneous	213. 70	32. 39	7. 16	215. 33	32. 46	5. 31	205. 29	31. 37	3. 66
Grand average	215. 92	34. 08	7. 18	226. 04	38. 61	4. 99	217. 14	39. 40	3. 56

The main results of the last three winter-packing seasons are as follows:

Year.	Aggregate net weight.	Aggregate lard product.	Aggregate cost paid.
1876-'77	1, 101, 478, 000	173, 877, 890	$79, 086, 127
1877-'78	1, 470, 506, 963	251, 193, 500	62, 338, 827
1878-'79	1, 624, 351, 264	294, 752, 358	57, 829, 592

Over 70 per cent. of the hogs were packed at six leading packing points. The following table shows the numbers packed, the average weight per head, and the average weight of lard at these six points during the last six years:

Cities.	1876-'77.			1877-'78.			1878-'79.		
	Numbers.	Average weight per head.	Average weight of lard.	Numbers.	Average weight per head.	Average weight of lard.	Numbers.	Average weight per head.	Average weight of lard.
Chicago	1, 618, 084	215. 97	35. 10	2, 501, 285	228. 37	39. 60	2, 943, 115	225. 15	44. 44
Cincinnati	523, 576	219. 77	38. 20	632, 302	227. 25	40. 96	623, 584	216. 46	36. 84
Saint Louis	414, 747	206. 42	32. 55	509, 540	216. 02	38. 20	629, 261	211. 20	40. 45
Milwaukee	225, 598	221. 73	30. 25	371, 982	232. 64	39. 81	444, 221	218. 77	36. 77
Louisville	214, 862	221. 12	32. 62	279, 414	222. 89	34. 83	187, 506	207. 17	32. 47
Indianapolis	294. 198	182. 50	26. 50	270, 150	195. 43	32. 05	472, 455	180. 55	26. 50
Total for these cities	3, 291, 065	213. 11	34. 00	4, 564, 673	224. 95	38. 91	5, 302, 142	217. 36	40. 41
Total for the West	5, 101, 308	215. 98	34. 03	6, 505, 446	226. 04	38. 61	7, 480, 648	217. 14	39. 40
Per cent. of the whole number	64. 51			70. 16			70. 89		

The proportion of the six cities is still on the increase. The falling off in weight is partly due to the fact that many immature hogs were packed. The amount of lard per head is steadily increasing.

SUMMER AND WINTER PACKING CONSOLIDATED.—The following table shows the results of the last three packing years, by seasons, in the West:

	Summer.	Winter.	Aggregate.	Average weight per head.	Aggregate.	Average weight of lard per head.	Aggregate.
				Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1876-'77	2, 357, 866	5, 101, 308	7, 409, 174	206. 01	1, 526, 357, 390	32. 79	243, 918, 870
1877-'78	2, 543, 120	6, 505, 446	9, 048, 566	216. 07	1, 955, 160, 434	37. 19	336, 557, 676
1878-'79	3, 373, 044	7, 480, 648	10, 858, 692	207. 77	2, 256, 158, 994	36. 72	408, 701, 858

IN THE EAST.

SUMMER AND WINTER PACKING.—*Seaboard cities:* The following table shows the receipts of live and dressed hogs during the last three packing years, by seasons, on the Atlantic coast:

Cities.	1876–'77.			
	Summer.		Winter.	
	Live.	Dressed.	Live.	Dressed.
Boston	233, 562	6, 688	126, 762	66, 433
New York	757, 104	7, 222	469, 042	65, 880
Philadelphia	201, 600	18, 400	95, 840	31, 340
Baltimore	175, 631	5, 000	88, 445	20, 000
Total	1, 369, 937	37, 310	780, 089	183, 653

Cities.	1877–'78.			
	Summer.		Winter.	
	Live.	Dressed.	Live.	Dressed.
Boston	213, 634	9, 565	141, 933	27, 907
New York	774, 157	17, 785	636, 127	38, 229
Philadelphia	210, 750	22, 400	93, 600	37, 250
Baltimore	196, 107	5, 000	128, 916	25, 000
Total	1, 394, 648	54, 750	1, 000, 962	128, 386

Cities.	1878–'79.			
	Summer.		Winter.	
	Live.	Dressed.	Live.	Dressed.
Boston	314, 861	411	208, 848	19, 531
New York	1, 045, 332	3, 334	776, 317	53, 401
Philadelphia	215, 820	26, 342	114, 910	48, 660
Baltimore	231, 816	2, 500	140, 328	27, 500
Total	1, 807, 829	32, 587	1, 232, 403	149, 092

Interior cities: The number packed in three interior cities of New York during three packing years is stated as follows:

Cities.	1876–'77.	1877–'78.	1878–'79.
Albany	30, 000	15, 000	33, 353
Troy	15, 000	15, 000	15, 000
Buffalo	135, 250	139, 930	201, 141
Total	180, 250	169, 930	249, 494

It is evident that the receipts of the seaboard cities represent hogs taken for daily consumption by butchers. There are no means of ascertaining what proportion of these are regularly "packed." This is evident from the great preponderance of the "summer" receipts. The

aggregates of the seaboard and interior cities for the last three years were as follows: 1876–'77, 2,551,239; 1877–'78, 2,703,676; 1878–'79, 3,222,011.

ON THE PACIFIC SLOPE.

In California there was a considerable increase in the number of hogs packed. High prices of transportation of the live animals caused the packing at interior points of many that would otherwise have been sent to San Francisco. Yet the latter city reports an enlargement of the business. The hogs of the Pacific slope are smaller than eastward of the Rocky Mountains. The average gross weight per head of hogs packed in 1878 at San Francisco was 185 pounds against 165 pounds in 1877, and 185 pounds in 1876. There is no distinction between summer and winter season, operations being carried on during the whole year; hence, our reports represent calendar years instead of "packing" years.

The numbers packed during the last three years in California were as follows: 1876—San Francisco, 175,000; interior points, 55,000; total for the State, 230,000. 1877—San Francisco, 135,000; other points, 85,000; total, 220,000. 1878—San Francisco, 155,000; other points, 125,000; total, 280,000. The average cost of hogs per cental was $3.87½ in 1878 against $5.62½ in 1877. The fall in prices has greatly discouraged this branch of production, which, it is supposed, will be considerably curtailed in 1879 for want of material. There is a growing export, especially of barreled meats, from San Francisco to the Pacific Islands and Asia. Imports of pork products from the east greatly increased during 1878, and are expected to still further increase during 1879. The high prices of transportation alone prevent a vast movement of this kind. While meats are shipped from Chicago to Liverpool at 45 cents per cental the same shipments to San Francisco are saddled with a freight tariff of $3 per cental.

The total number of hogs packed in Oregon in 1878 was 120,000 against 90,000 in 1877 and 75,000 in 1876. Portland does most of the business. A small export to British Columbia is all that is sent out of the State.

The total numbers packed on the Pacific slope during the last three years were as follows: 1876, 305,000; 1877, 310,000; 1878, 400,000.

RECAPITULATION.

The total number of hogs packed in the United States during the last three years is as follows:

Section.	1876–'77.	1877–'78.	1878–'79.
The West	7,409,174	9,048,566	10,858,692
The East	2,551,239	2,703,670	3,222,011
The Pacific slope	305,000	310,000	400,000
Total	10,265,413	12,062,236	14,480,703

It is believed that hog-producers also packed an increased number on private account during the last "packing year." A large surplus of the previous year remains to swell the production of 1878–'79. To all appearance, then, there is a vast enlargement of the oversupply. Whether new outlets will be opened for its disposal remains to be seen. Our foreign export of hog-products shows a vast increase. Reports from

the Bureau of Statistics of the Treasury show the export of the last two calendar years as follows:

Section.	1877.		1878.	
	Pounds.	*Values.*	*Pounds.*	*Values.*
The West	436, 046, 720	$43, 934, 084	695, 617, 067	$54, 827, 455
The East	65, 813, 941	5, 364, 791	83, 743, 710	5, 055, 573
The Pacific slope	237, 069, 523	23, 489, 433	358, 317, 129	28, 476, 228
Total	738, 930, 184	72, 788, 308	1, 137, 677, 906	88, 359, 256

While we added nearly one-third to the quantity of our exports the increase of values was but 18 per cent. This decrease in prices largely accounts for the immense increase in quantities. The exports by fiscal years will be found under the head of agricultural exports.

EUROPEAN STATISTICS.

The statistical inquiries of Great Britain are made annually on the 4th of June, and the returns are compiled, tabulated, and published by the statistical department of the Board of Trade. From those gathered in June, 1878, we have returns from 556,809 occupiers of land, being all who occupy more than half an acre. In Ireland, where the returns are made by the registrar-general, they include all holders of land, however small.

In Great Britain the area returned as under cultivation has increased since 1877 by 142,000 acres, and by more than a million and a half acres since 1869. This increased acreage is not altogether due to new land being broken up, but results from a more correct return and from land reclaimed from mountains and marshes.

In Ireland there is a further decrease of 82,000 acres in the cultivated area, which in 1877 amounted to a decrease of 300,000 acres. Looking at the different crops in detail we notice that the area in wheat in the United Kingdom was increased nearly 2 per cent. over 1877 and 8 per cent. over 1876, but that the average of the last three years has been below that of the previous seven. There was also an increase of 2 per cent. in the area sown in barley, but oats show an equal decline. Beans show a decrease of 12 per cent., and pease 9 per cent. The decline since 1869 has been very considerable, and shows that there are only 11,000,000 acres in all cereals against 12,000,000 in 1869.

In the green crops there is no material change; a slight increase in pasture and hay is reported.

In live stock we find a slight increase in horses; the importation continues from abroad, there having been imported 30,524 in 1877. The decrease of cattle in 1877 has not continued in 1878, and there is a slight increase; the collectors state that the competition of American beef has caused less to be bred. Sheep have somewhat declined in number. Pigs have slightly declined in Great Britain and by as much as 12 per cent. in Ireland.

Many collectors cite the increasing competition of American bacon as diminishing the stock materially. It appears that during the first eight months of 1878 the total imports of bacon into Great Britain were 2,404,000 cwts., which exceed by 743,000 cwts. the imports of the same period of 1877.

In view of the intimate commercial relations between the two countries

and the great influence upon the prices of our crops exercised by England, the following table is presented.

Under the title of United Kingdom we have included Ireland, Isle of Man, and Channel Islands.

From the estimates for grass and fallow lands in the United Kingdom are excluded heaths, mountains, and woods; from the estimates for the United States under the same heading are excluded the forests and the uncultivated prairies of the West.

With a population proportioned to ours as 36 to 48, it will be seen at a glance how much greater is our proportion in the real basis of national wealth.

Agricultural returns for 1878.

United Kingdom.		United States.	
Total acreage in crops, fallow, and hay.	47,327,000	Total acreage in crops, fallow, and hay.	179,000,000
Wheat (acres)	3,382,000	Wheat (acres)	32,000,000
Oats (acres)	4,124,000	Oats (acres)	13,176,000
Barley (acres)	2,723,000	Barley (acres)	1,790,000
Total in all cereals, including pease and beans	11,030,000	Total of cereals, including corn	97,960,000
Potatoes	1,365,000	Potatoes	1,776,000
Turnips and other green crops	3,400,000	Cotton, sugar, and tobacco	13,000,000

LIVE STOCK.

Horses	1,927,000	Horses	10,611,000
Cattle	9,761,000	Cattle	31,850,000
Sheep	32,571,000	Sheep	36,575,000
Hogs	3,768,000	Hogs	33,134,000
Total live stock	48,027,000	Total live stock	112,170,000

Average yield per acre in Great Britain for 1878.

Wheat	bushels..	30
Oats	bushels..	50
Barley	bushels..	36
Potatoes	bushels..	166
Hay	tons..	2+

The agricultural statistics of France, as published in 1876, are as follows:

	Acres.
Total area	130,910,000
Cultivated area	101,200,000
Area in cereals	37,050,000

Crop.	Acres.	Bushels.	Bushels per acre.
Wheat	16,942,861	271,049,123	16
Spelt	1,168,315	20,239,058	17.32
Rye	4,539,596	75,221,677	16.57
Barley	2,665,977	52,713,848	19.77
Buckwheat	1,630,318	16,768,396	10.28
Corn	1,632,946	20,151,166	12.34
Oats	8,647,512	209,461,607	24.22
Potatoes	3,085,620	332,054,473	107.61

For the year 1878 we extract from L'Economiste Francais for the month of September:

The acreage of wheat since 1876 has increased to 17,206,020 acres,

while the acreage of oats has declined to 7,859,540. In the other crops the acreage has changed but slightly.

The wheat yield of 1878 was a very poor one and below the crop of 1877, which was itself below average, being for 1878 232,880,000 bushels, only 13.5 bushels per acre, and nearly 38,000,000 less than 1877. The number of farm animals shows a slight decrease since the number reported in 1866, and is for 1878 48,663,000 head, classed as follows:

Farm animals.	Percentage.	Number.
Sheep	53	25,791,290
Cattle	24	11,679,120
Hogs	12	5,839,560
Horses	6	2,919,780
Goats	4	1,946,520
Mules and asses	1	486,630

Since 1850 there has been a decline of 10 per cent. in sheep, an increase of 15 per cent. in hogs, and nearly 80 per cent. increase in goats, an animal so prejudicial to agriculture that it is, in fact, often taken as a sure indication of shiftlessness and poverty.

In the estimates of numbers of farm animals for Europe, the division of the different classes is:

Total number of horses		31,000,000
Russia	16,000,000	
France	2,900,000	
Prussia	2,258,000	
Great Britain	2,000,000	
Hungary	2,158,000	
Italy	478,000	
Total number of cattle		89,000,000
Russia	22,000,000	
France	11,600,000	
Great Britain	10,000,000	
Prussia	8,000,000	
Italy	3,000,000	
Total number of sheep		194,000,000
Russia	46,000,000	
Great Britain	32,500,000	
France	26,000,000	
Spain	22,000,000	
Prussia	19,000,000	
Hungary	15,000,000	
Italy	7,000,000	

In respect to the amount of area susceptible of cultivation in the different countries of Europe nature has been very diverse. Inaccessible and arid mountains, and lands subject to overflow of the sea, constitute the greater portion of lands classed as not arable. The percentage of lands not arable is greatest in Norway, being 72 per cent. of the whole; next comes Sweden, then Portugal, while Bavaria and Würtemberg have the least proportion not susceptible of cultivation, being less than 2 per cent. Great Britain has 28 per cent. not susceptible of cultivation, Ireland 13 per cent., and France only 9 per cent. The amount of land devoted to cereal crops and to fallow and pasture also differs greatly, according to the habits and traditions of the inhabitants. Belgium has the largest proportion of land in cultivation, having 59 per cent.; France has 53 per cent., and Great Britain 39.

It has been estimated, and accepted as a fact in Europe, that the consumption of grain for the whole country is 15½ bushels per capita annu-

ally. In view of that basis it is interesting to note the production in the most important countries in comparison with their population. Among those which raise more than the amount "per capita" needed Russia stands first, and in an average year has 23 bushels for each person; Prussia produces 22.7; France, 19.5; Hungary, 19.3. On the other hand, of those which produce too small an amount, Belgium has 14; Spain, 14; Ireland, 13; Great Britain, 11.9; Holland, 9; Italy, 8.

CONCLUSION.

In conclusion, allow me to add that the demands from members of Congress, State institutions, and persons interested in special statistics have been larger than usual this year.

It is the province of agricultural statistics to measure the extent of our resources; to contrast the actual with the possible in our production; to estimate the effect of overproduction in the diminution of prices; and to mark the progress of science in its application to the business of the cultivator and aid the ruralist in keeping pace with such progress.

The clerical force employed in this division consists of the statistician, one assistant, and five clerks, engaged in tabulating and computing the returns, a force totally inadequate to a proper and thorough investigation of many matters of great and increasing interest.

CHARLES WORTHINGTON,
Statistician.

Hon. WM. G. LE DUC,
Commissioner.

INVESTIGATION OF SWINE PLAGUE.

Congress having previously appropriated the sum of $10,000 for defraying the expenses of a commission to investigate and determine the causes producing, and, if possible, discover remedies for, some of the more contagious and destructive diseases incident to domesticated animals, early in August last the Commissioner of Agriculture appointed examiners in the States of New York, Indiana, Illinois, Iowa, Kansas, Missouri, and North Carolina, to conduct such investigation. Still later in the season, on receiving information that not only diseases among swine were prevailing to an alarming extent in Virginia, but that a fatal disease resembling pleuro-pneumonia or contagious lung fever was destroying a good many valuable dairy cattle in some localities of that State, an additional examiner was appointed and instructed to investigate and report upon all the facts connected with the condition of both classes of animals in the infected districts of this State.

In the preliminary report of the Commissioner of Agriculture for 1877, on the subject of diseases of domesticated animals, a tabular statement gives the total value of farm animals lost in the United States during that year, principally from infectious and contagious diseases, at $16,653,428. These losses were based upon as accurate returns as could be obtained in the absence of an absolute census, but as they included data from but eleven hundred and twenty-five counties (about one-half the whole number of counties in the United States), the above sum falls far below the aggregate losses for that year. About two-thirds of this sum was occasioned by the loss of swine by diseases presumed to be of an infectious and contagious character. Notwithstanding these maladies had their origin near a quarter of a century ago, and had rapidly spread from one State and one county to another, there was great diversity of opinion as to their contagious or non-contagious character. Many intelligent farmers and stock-growers insisted that they were not transmissible from one animal to another, while perhaps equally as large a number contended that the diseases were of a highly infectious and contagious nature. As this was regarded as one among the most important facts to be determined by the investigation, two of the examiners devoted most of their time to experiments looking to a solution of this problem.

As the number and value of the annual losses among swine were much heavier than among all other classes of domesticated animals combined, the Commissioner deemed it best to devote the greater portion of the limited sum placed at his disposal to an investigation of the fatal diseases affecting this class of farm animals.

The preliminary investigation instituted and conducted under the supervision of this department, in the fall and winter of 1877–'78, established the fact that diseases prevail among these animals much more extensively during the late summer and early fall months than at other seasons of the year, and for this reason the examiners selected to conduct the investigation were employed for periods ranging from one to three months. It was assumed, and the subsequent history of the disease proved the assumption to be well founded, that the reduced temperature of the late fall and early winter months would cause an abatement of the disease, and in a measure deprive the examiners of subjects with which to continue their experiments. While, therefore, the very

severe weather of the past winter caused a great reduction in the number of animals affected, the disease was not eradicated, nor did its fatality seem to be lessened. The spread of the infection from one herd to another was greatly diminished; but, in infected herds, where the malady was still prevailing when cold weather set in, there appeared but little difference in the rapidity of the transmission of the disease, from one animal to another, in the same herd. Dr. H. J. Detmers, V. S., of Chicago, who conducted his investigations and made his experiments in one of the worst infected of the many large hog-growing districts in Illinois, writing under date of January 7th last, speaks as follows of the effects of severe frosts on the spread of the disease:

Since my last letter the weather has continued extremely cold. Where I now am, in Lee County, some five or six miles west of Dixon, the thermometer indicated at seven o'clock on the morning of January 2, 28° below zero, and on the next morning 24° below zero. At present—to-day, yesterday and day before—the weather is a little milder. To-day it tried to snow a little; otherwise the sky has been clear every day. The wind is, and has been, west, except yesterday afternoon, when it was almost due south. Swine-plague during this cold weather does not seem to spread either so readily or so rapidly from one farm to another as a few months ago; but as to its spreading from one animal to another in the same herd in which it previously existed no difference can be observed. It seems to be just as fatal as in August, and its course, on the whole, is probably more acute, as severe affections of the lungs and of the heart are more frequent, a fact easily explained in the habits of swine crowding together and lying on top of each other in their sleeping places when the temperature is very low.

Dr. James Law, of Ithaca, N. Y., whose investigations were solely confined to experiments intended to further establish the contagious and infectious character of the disease, the period of its incubation, &c., confirms the statement of Dr. Detmers, *i. e.*, that the severe frosts of winter do not destroy the germs of the malady but simply retard their conveyance from one herd to another. In a letter of recent date, forwarded since his report was completed, Dr. Law says:

I have demonstrated that the freezing of the virulent matter does not destroy its activity, and that the virus loses nothing in potency by preservation for one or two months closely packed in dry bran. The same may be inferred of all other situations when it is closely packed and where the air has imperfect access. These two last points are of immense importance as bearing on the question of the preservation of the poison in infected pens and yards alike in winter and in summer, to say nothing of its possible conveyance in fodder, &c. The different modes in which the disease may be conveyed in the wet and dry condition, and in the bodies of rabbits, and probably sheep and other animals, speak in the strongest terms against keeping up the production of the poison by preserving sick animals, unless where they can be secluded in thoroughly disinfected buildings in which even the air shall be constantly charged with disinfectants.

In most of the States in which investigations have been made, the examiners have found the symptoms and *post-mortem* appearances of the disease the same, and hence agree as to the propriety of designating the affection under the head of a general disorder. Dr. Detmers has, therefore, given the disease the name of "Swine-plague," and Dr. Law has named it "Hog-fever." While either designation would seem to be eminently proper, that of "Swine-plague" will no doubt be generally adopted.

As in almost all general disorders, a certain variety of organs were found affected and diseased. Marked changes and extravasations in various parts of the body were observed, and inflammation of the lungs and large intestines was usually present. The heart, the pleura, the eyes, the epidermis, and many other important organs showed either slight or more serious affections, and in almost every case tested with the thermometer the temperature was found to be above normal heat

before any other symptom of the disease was in the least apparent. In every herd where the disease had prevailed to any considerable extent, no case was found where death had occurred from a local malady, but all the lesions and appearances unmistakably indicated the existence of the general disorder. In but few cases was death found to have resulted from the affection of any single organ, but on the contrary seemed to have been the result of the various organic changes observed.

Dr. Detmers says that the morbid process, although in all cases essentially the same, is not restricted to a single part or organ, or to a set of organs, but can have its seat almost anywhere—in the tissue of the lungs; in the pleura and pericardium; in the heart; in the lymphatic system; in the peritoneum; in all mucous membranes, especially in those of the intestines; in the liver; in the spleen, and even in the skin. Only the pulmonal tissue and lymphatic glands are invariably affected.

The most constant and unvarying symptom of the disease is observed in the increased temperature of the body. Indeed, one of the examiners regards it as highly probable that a high temperature may exist several weeks before other symptoms are manifested, and that the disease may in some cases even be confined to and run its course in the blood without a localization in any other organ or organs. A few isolated cases are noted where this symptom was lacking, but it may have been present in a mild form before other symptoms were observed. The external symptoms of the disease, which were found to be almost identical in all the widely-separated localities in which examinations were made, were a dullness of the eyes, the lids of which are kept nearer closed than in health, with an accumulation of secretion in the corners. There is hanging of the head, with lopped ears, and an inclination to hide in the litter and to lie on the belly and keep quiet. As the disease advances, the animal manifests more or less thirst, some cough, and a pink blush or rose-colored spots, and papular eruption appears on the skin, particularly along the belly, inside of the thighs and fore legs, and about the ears. There is accelerated respiration and circulation, increased action of the flanks in breathing, tucked-up abdomen, arched back, swelling of the vulva in the female as in heat; occasionally, also, of the sheath of the male, loss of appetite, and tenderness of the abdomen, sometimes persistent diarrhea, but generally obstinate constipation. In some cases large abraded spots are observed at the projecting points of the body, caused by separation and loss of the epidermis. In such cases a slight blow or friction on the skin is sufficient to produce such abrasions. In many cases the eruption, blush, and spots are entirely absent; petechiæ are formed in only about one-third of the cases. In some cases there is considerable inflammation of and discharge from the eyes. Some animals emit a very offensive odor even before death. In large herds, where the disease prevails extensively, this offensive effluvia can be detected for a great distance to windward. In nearly all cases there is a weakness or partial paralysis of the posterior extremities, and occasionally this paralysis is so complete in the first stages of the disease as to prevent walking or standing.

As symptoms of special diagnostic value, which are scarcely ever absent in any case, the following are mentioned: Drooping of the ears and of the head; more or less coughing; dull look of the eyes; staring appearance of the coat of hair; partial or total want of appetite for food; vitiated appetite for excrements; rapid emaciation; great debility; weak and undecided, and frequently staggering, gait; great indifference to surroundings; tendency to lie down in a dark corner, and to hide the nose and even the whole head in the bedding; the specific offensive

smell, and the peculiar color of the excrements. This last symptom is always present, at least in an advanced stage of the disease, no matter whether constipation or diarrhea is exisiting. Among other characteristic symptoms, which are not present in every animal, may be mentioned frequent sneezing; bleeding from the nose; swelling of the eyelids; accumulation of mucus in the inner canthi of the eyes; attempts to vomit, or real vomiting; accelerated and difficult breathing; thumping or spasmodic contraction of the abdominal muscles (flanks), and a peculiar, faint, and hoarse voice in the last stages of the disease.

The duration of the disease varies according to the violence and seat of the attack and the age and constitution of the patient. Where the attack is violent, and its principal seat is located in one of the vital organs—such as the heart—the disease frequently terminates fatally in a few days, and sometimes even within twenty-four hours; but when the attack is of a mild character, and the heart is not seriously affected, and the animal is naturally strong and vigorous, one or two weeks usually intervene before death ensues. If the termination is not fatal, convalescence requires an equal and not unfrequently a much longer time. A perfect recovery seldom occurs; in most cases some lasting disorder remains behind and more or less interferes with the growth and fattening of the animal. Those that do recover make but very poor returns for the food consumed; hence from a pecuniary standpoint it makes but little difference to the owner whether the animal recovers or not. The attack is always more violent and fatal when large numbers of animals are closely confined together in small and dirty inclosures or in illy ventilated and filthy pens.

The disease can have its seat in many different organs or parts of the body, and therefore produces a great variety of morbid changes. This accounts for its different aspect in different animals. In some cases the principal seat of the disease may be in the organs of respiration and circulation, and in others in the intestinal canal and organs of digestion. Death may therefore be the result of different causes in different cases. In some cases it results from a cessation of the functions of the heart, the lungs, &c., and in others it is in consequence of the inability of entirely different organs to perform their allotted functions. This being the case, the *post-mortem* appearances would necessarily greatly vary, but in all animals similarly affected the lesions and morbid changes were found identical.

Perhaps the most important point to be determined by this investigation was the contagious or non-contagious character of the disease. In order to do this a series of experiments were instituted and conducted solely with this end in view, by Drs. Detmers and Law. These experiments resulted in determining the fact that the disease is both infectious and contagious, and that it is not confined alone to swine, but that other animals may contract it in a mild form and retransmit it to swine in its most virulent and malignant character.

On the 6th day of September, Dr. Detmers fed a portion of the stomach, the cæcum, and the spleen of a pig that had died on that day to two healthy pigs. On the 19th of the same month they showed signs of illness, and the symptoms continued to grow in intensity until the 23d, when, finding that the animal must die in a few hours, one of them was killed by bleeding. The other pig was found dead in the pen on the morning of September 30. The symptoms and *post mortem* appearances were those of swine-plague, as they revealed the same lesions as those observed in an examination of the pig from which the diseased products had been taken for the purpose of infection. On the 24th day of Sep-

tember, the day following the death of the first pig, a healthy pig of mixed Poland-China and Berkshire was confined in the same pen with the sick pig that died on the 30th of that month. It showed no signs of sickness until the 2d day of October, when the first symptoms of the disease were observed. It continued to grow rapidly worse, and was found dead in its pen on the morning of the 11th, nine days after the first symptoms were observed.

Experiments were made with a large number of other animals to test the infectious and contagious character of the plague. These experiments included the confinement of healthy with sick animals, and the inoculation of healthy animals with the diseased products of those suffering with the fever. In almost every case, as will be seen from his detailed report, Dr. Detmers was successful in transmitting the disease from sick to healthy animals.

The microscopic investigations of Dr. Detmers also revealed some important facts. His discovery of a new order of *bacteria* or *bacillus*, which he names *bacillus suis*, as it is common only to this disease of swine, and his failure to inoculate healthy animals with virus from which these germs had been removed by filtration and otherwise, would lead to the conclusion that these microphytes are the true seeds of the hog fever.

Dr. Detmers invariably found these germs, in one form or another, in all fluids. So constantly were they observed in the blood, urine, mucus, fluid exudations, &c., and in the excrements and in all morbidly affected tissues of diseased animals, that he regards them as the true infectious principle. They would seem to undergo several changes, and to require a certain length of time for further propagation; therefore, if introduced into the animal organism, a period of incubation or colonization must elapse before the morbid symptoms make their appearance. These germs were generally found in immense numbers in the fluids, but more especially in the blood and in the exudations of the diseased animals. With the proper temperature and the presence of a sufficient amount of oxygen they soon develop and grow lengthwise by a kind of budding process. A globular germ, constantly observed under the microscope, budded and grew under a temperature of 70° F. twice the original length in exactly two hours, and changed gradually to rod-bacteria or *bacilli*. Under favorable circumstances these *bacilli* continue to grow in length until, when magnified 850 diameters, they appear from one to six inches long. A knee or angle is first formed where a separation is to take place, and then a complete separation is effected by a swinging motion of both ends. After the division, which requires but a minute or two after this swinging motion commences, the ends thus separated move apart in different directions. These long bacteria seem pregnant with new germs; their external envelope disappears or is dissolved, and then the numerous bacillus germs become free, and in this way effect propagation. Some of the *bacilli* or rod-bacteria move very rapidly, while others are apparently motionless. A certain degree of heat would seem to be necessary for their propagation, as, under the microscope, the motion increases and becomes more lively if the rays of the light, thrown upon the slide by the mirror, are sufficiently concentrated to increase the temperature of the object. Another change observed by Dr. Detmers, but the cause of which he was not able to determine, was observed in the fact that the globular bacteria or bacillus germs commence to bud or grow, when, very suddenly, their further development ceases, and partially developed *bacilli* and simple and budding germs congregate to colonies, agglutinate to each other, and form larger or smaller irregularly-shaped and apparently viscous clusters. These clusters are frequently found in

the blood and in other fluids, and invariably in the exudations of the lungs; and in the lymphatic glands in pulmonal exudation and in blood serum this formation can be observed under the microscope if the object remains unchanged for an hour or two. In the ulcerous tumors on the intestinal mucous membrane but few of these clusters will be found, but the fully-developed *bacilli*, many of which appear very lively, are always exceedingly numerous. These tumors or morbid growths in the intestines seem to afford the most favorable conditions for the growth and development of the *bacilli* and their germs. The presence of such immense numbers of these microphytes and their germs in the excrements and other morbid products of swine leads Dr. Detmers to regard them, beyond doubt, as the principal disseminators of the plague. Whether these colonies or viscous clusters are instrumental in bringing about the extensive embolism of the lungs and other tissues by merely closing the capillary vessels in a mechanical way, or whether the presence, growth, development, and propagation of the *bacilli* and their germs produce peculiar chemical changes in the composition of the blood, thereby disqualifying it from passing with facility through the capillaries, or which cause a clotting and retention of the same in the capillary system, Dr. Detmers is not able positively to decide. He is of the opinion, however, that these colonies or viscous clusters of bacillus germs and partially developed *bacilli* cause sufficient obstruction of the capillaries to produce fatal embolism.

The vitality of the *bacilli* and bacillus-germs is not very great, except where preserved in a substance or fluid not easily subject to decomposition; for instance, in water which contains a slight admixture of organic substances. Where contained in such a fluid and preserved in a vial with a glass stopper, they will remain for at least five or six weeks in nearly the same condition, or develop very slowly, according to the amount of oxygen and degree of temperature maintained. In an open vessel the development is a more rapid one. If oxygen is excluded, or the amount available is exhausted, no further change takes place. In the water of streamlets, brooks, ditches, ponds, &c., their vitality is retained or preserved for some time. In fluids and substances subject to putrefaction, they lose their vitality and are destroyed in a comparatively brief period; at least they disappear as soon as those fluids and substances undergo decomposition. In the blood they disappear as soon as the blood-corpuscles commence to decompose or putrefy. They are also destroyed if brought in contact with or acted upon by alcohol, carbolic acid, thymol, iodine, &c. The destruction of these germs by decomposition would seem to account for the harmless nature of thoroughly putrid products when consumed by healthy animals. (See drawings, *bacilli* and *bacillus-germs*.)

Dr. Law also discovered bacteria in the blood of pigs suffering with the disease, and in one case, on the second day before death, he found the blood swarming with them, all showing very active movements. (See drawings, Plate xiii, Fig. 3.) The blood from another pig, which had been inoculated from this one, showed the same living, actively-moving germs in equal quantity. They were further found in the blood of a rabbit and of a sheep inoculated from the first-mentioned pig. In an abscess of a puppy, which had also been inoculated, the germs were abundant. In the examination of blood from healthy pigs the microscope failed to reveal the presence of these organisms. Dr. Law states that in his experiments the greatest precautions were taken to avoid the introduction of extraneous germs. The caustic potash employed was first fused, then placed with reboiled distilled water in a stoppered bot-

tle which had been heated to red heat. The glass slides and cover-glasses were cleaned and burned, the skin of the animal cleaned and incised with a knife that had just been heated in the flame of a lamp. The caustic solution and the distilled water for the immersion-lens were reboiled on each occasion before using, and finally the glass rods employed to lift the latter were superheated before being dipped in them. On different occasions, when the animal was being killed, the blood from the flowing vessels was received beneath the skin into a capillary tube which had just been purified by burning in the flame of a lamp. With these precautions he thinks it might have been possible for one or two bacteria to get in from the atmosphere, but this would not account for the swarms found as soon as the blood was placed under the microscope.

The most scrupulous care was observed by Dr. Law in his experiments in inoculation. The isolated and non-infected locality where the experiments were conducted offered special advantages for a series of experiments of this character, as there were no large herds of diseased and exposed swine, and, consequently, no danger of accidental infection from other sources than the experimental pens. The number of animals subjected to experiment was limited by the necessity for the most perfect isolation of the healthy and diseased, for the employment of separate attendants for each, and for the disinfection of instruments used for scientific observations, and of the persons and clothes of those necessarily in attendance. The experimental pens were constructed on high ground in an open field, with nothing to impede the free circulation of air. They were large and roomy, with abundant ventilation from back and front, with perfectly close walls, floors, and roofs, and in cases where two or more existed in the same building, the intervening walls were constructed of a double thickness of matched boards, with building pasteboard between, so that no communication could possibly take place except through the open air of the fields. When deemed necessary, disinfectants were placed at the ventilating orifices. On showing the first signs of illness, infected pigs were at once turned over to the care of attendants delegated to take charge of these alone. The food, utensils, &c., for the healthy and diseased animals were kept most carefully apart. When passing from one to the other for scientific observations, the healthy were first attended, and afterward the diseased, as far as possible in the order of severity. Disinfection was then resorted to, and no visit was paid to the healthy pigs until after a lapse of six or eight hours, with free exposure to the air in the interval. In the pens the most scrupulous cleanliness was maintained, and deodorizing agents used in sufficient quantities to keep them perfectly sweet.

The experiments of Dr. Law have shown the period of incubation to vary greatly, though in a majority of cases it terminated in from three to seven days after inoculation. One animal sickened and died on the first day, three on the third, two on the fourth, one on the fifth, two on the sixth, four on the seventh, and one each on the eighth and thirteenth days respectively. Referring to experiments of others for determining the period of incubation, Dr. Law says that Dr. Sutton, observing the result of contact alone in autumn, sets the period at from thirteen to fourteen days; his own observations in Scotland, in summer, indicated from seven to fourteen days; Professor Axe, in summer, in London, concluded on from five to eight days; Dr. Budd, in summer, from four to five days; and Professor Osler, in autumn, at from four to six days. Dr. Detmers gives the period of incubation from five to fifteen days, or

an average of about seven days. A comparison of these results would seem to indicate that both extremes have been reached.

In experimenting in this direction, Dr. Law first sought to ascertain the tenacity of life of the dried virus. Some years ago Professor Axe had successfully inoculated a pig with virus that had remained dried upon ivory points for twenty-six days. In order to carry this experiment still further, Dr. Law inoculated three pigs with virulent products that had been dried on quills for one day, one with virus dried on a quill for four days, one for five days, and one for six days. These quills had been sent from North Carolina and New Jersey, wrapped in a simple paper covering, and were in no way specially protected against the action of the air. Of the six inoculations, four took effect. In the two exceptional cases the quills had been treated with disinfectants before inoculation, so that the failure was anticipated.

Three pigs were inoculated with diseased intestine which had been dried for three and four days respectively. The intestine was dried in the free air and sun, and the process was necessarily slower than in the case of the quills, where the virus was in a very thin layer, hence there was more time allowed for septic changes. In all three cases the inoculation proved successful. This experiment would prove that the morbid products, even in comparatively thick layers, may dry spontaneously, and retain their vitality sufficiently to transmit the disease to the most distant States.

Another pig was inoculated with a portion of moist diseased intestine sent from Illinois in a closely-corked bottle. The material had been three days from the pig, and smelt slightly putrid. The disease developed on the sixth day. A second pig was inoculated with blood from a diseased pig that had been kept for eleven days at 100° F. in an isolation apparatus, the outlets of which were plugged with cotton wool. Illness supervened in twenty-four hours.

A solitary experiment of Dr. Klein's having appeared to support the idea that the blood was non-virulent, Dr. Law tested the matter by inoculating two pigs with the blood of one that had been sick for nine days. They sickened on the seventh and eighth days respectively, and from one of these the disease was still further propagated by inoculating with the blood three other animals. Notwithstanding the success of these three experiments, Dr. Law is still doubtful of the blood being virulent at all stages of the disease.

But one or two experiments were instituted by Dr. Law to test the question of infection through the air alone. A healthy pig placed in a pen between two infected ones, and with the ventilating orifices within a foot of each other, front and back, had an elevated temperature on the ninth, tenth, and eleventh days, with lameness in the right shoulder, evidently of a rheumatic character. On the twenty-fourth day the temperature rose two degrees, and remained 104° F. and upward for six days, when it slowly declined to the natural standard.

A healthy pig was placed in a pen from which a sick one had been removed thirteen days before. The pen had been simply swept out, but subjected to no disinfection other than the free circulation of air, and as the pig was placed in the pen on December 19th, all moist objects had been frozen during the time the apartment had stood empty. The pig died on the fifteenth day thereafter, without having shown any rise of temperature, but with *post-mortem* lesions that showed the operation of the poison. Dr. Law refers to this case as an example of the rapidly fatal action of the disease, the poison having fallen with prostrating effect on vital organs—the lungs and brain—and cut life short before there was time

for the full development of all the other lesions. It fully demonstrates the preservation of the poison in a covered building at a temperature below the freezing point.

Perhaps the most important experiments conducted by Dr. Law were those relating to the inoculation of other animals than swine with the virus and morbid products of pigs suffering with the plague, and the transmission of the disease from these animals back to healthy hogs. A merino wether, a tame rabbit, and a Newfoundland puppy were inoculated with blood and pleural fluid containing numerous actively moving bacteria, taken from the right ventricle and pleuræ of a pig that had died of the fever the same morning. Next day the temperature of all three was elevated. In the puppy it became normal on the third day, but on the eighth day a large abscess formed in the seat of inoculation and burst. The rabbit had elevated temperature for eight days, lost appetite, became weak and purged, and its blood contained myriads of the characteristic bacteria. The wether had his temperature raised for an equal length of time, and had bacteria in his blood, though not so abundantly as in that of the rabbit. The sheep and rabbit had each been unsuccessfully inoculated on two former occasions with the blood of sick pigs, in which no moving bacteria had been detected. Subsequently, after two inoculations with questionable results, made with the blood of sick pigs in which no microzymes had been observed, Dr. Law succeeded in inoculating a rabbit with the pleural effusion of a pig that had died the night before, and in which were numerous actively moving bacteria. Next day the rabbit was very feverish and quite ill, and continued so for twenty-two days, when it was killed and showed lesions in many respects resembling those of the sick pigs. The blood of the rabbit contained active microzymes like those of the pig. On the fourth day of sickness the blood of the rabbit containing bacteria was inoculated on a healthy pig, but for fifteen days the pig showed no signs of illness. It was then reinoculated, but this time with the discharge from an open sore which had formed over an engorgement in the groin of the rabbit. Illness set in on the third day thereafter and continued for ten days, when the pig was destroyed and found to present the lesions of the disease in a moderate degree. A second pig, inoculated with frozen matter which had been taken from the open sore on the rabbit's groin, sickened on the thirteenth day thereafter, and remained ill for six days, when an imminent death was anticipated by destroying the animal. During life and after death it presented the phenomena of the plague in a very violent form.

The results of these experiments have convinced Dr. Law, as they must convince others, that the rabbit is itself a victim of this disease, and that the poison can be reproduced and multiplied in the body of this animal and conveyed back with undiminished virulence to the pig. Dr. Klein had previously demonstrated the susceptibility of mice and guinea pigs to the disease. The rabbit, and still more the mouse, is a frequent visitor of hog pens and yards. The latter eats from the same feeding troughs with the pig, hides under the same litter, and runs constant risk of infection. Once infected, they may carry the disease to long distances. During the progress of severe attacks of the disease, their weakness and inability to escape will make them an easy prey to the omnivorous hog; and thus sick and dead alike will be devoured by the doomed swine.

Dr. Law says that the infection of these rodents creates the strongest presumption that other genera of the same family may also contract the disease, and by virtue of an even closer relation to the pigs, may succeed

in conveying the malady to distant herds. The rat is suggested as being almost ubiquitous in piggeries, and more likely than any other rodent to contract and transmit the disease to distant farms. In order to test its susceptibility to the poison, Dr. Law inoculated a rat with the virus from a sick pig, but unfortunately the subject died on the second day thereafter. The body showed slight suspicious lesions, such as congested lungs with considerable interlobular exudation, congested small intestines, dried-up contents of the large intestines, and sanguinous discoloration of the tail from the seat of inoculation to the tip. With the fresh congested small intestine of the rat he inoculated one pig, and with the frozen intestine one day later he inoculated a second. The first showed no rise of temperature, loss of appetite, or digestive disorder; but on the sixth day pink and violet eruptions, the size of a pin's head and upwards, appeared on the teats and belly; and on the tenth day there was a manifest enlargement of the inguinal glands. In the second pig inoculated, the symptoms were too obscure to be of any real value. Dr. Law will continue his experiments with this rodent.

In addition to the above, Dr. Law experimented on two sheep of different ages, an adult merino wether and a cross-breed lamb, and in both cases succeeded in transmitting the disease. With the mucus from the anus of the wether he inoculated a healthy pig, which showed a slight elevation of temperature for five days, but without any other marked symptoms of illness. Eleven days later it was reinoculated with scab from the ear of the lamb, and again three days later with anal mucus from the sheep. The day preceding the last inoculation it was noticed that the inguinal glands were much enlarged, and in six days thereafter the temperature was elevated and purple spots appeared on the belly. At the time that Dr. Law closed his report this fever had lasted but a few days, but he regards the symptoms, taken in connection with the violent rash and the enlarged lymphatic glands, as satisfactory evidence of the presence of the disease. It can, therefore, be affirmed of the sheep as of the rabbit, that not only is it subject to this disease, but that it can multiply the poison in its system and transmit it back to the pig.

Among the later experiments by Dr. Law was one inaugurated with the view of testing the vitality of frozen products of the disease. This point was briefly alluded to above, but its importance would seem to call for further attention. In two cases healthy pigs were inoculated with virulent products which had been frozen hard for one and two days respectively. In both instances the resulting disease was of a very violent type, and would have proved fatal had it been left to run its course. The freezing had failed to impair the virulence of the product; on the contrary, it had only sealed it up to be opened and given free course on the recurrence of warm weather. Once frozen no change could take place until it was again thawed out, and if it was preserved for one night unchanged in its potency, it would be equally unaffected after the lapse of many months, provided its liquids had remained in the same crystalline condition throughout. It is in this way, no doubt, that the virus is often preserved through the winter in pens and yards, as well as in cars and other conveyances, to break out anew on returning spring. The importance of this discovery, as applied to preventive measures, cannot be overestimated. Infected yards and other open and uncovered places may not be considered safe until after two months' vacation in summer, and not then if sufficient rain has not fallen during the interval to insure the soaking and putrid decomposition of all organic matter near the surface. This will be made more apparent by reference to an experiment which

resulted in the successful inoculation of pigs with virus that had been kept for a month in dry wheat bran. In winter, on the other hand, the yard or other open and infected place may prove non-infecting for weeks and even months and yet retain the virus in readiness for a new and deadly course as soon as mild weather sets in. Safety under such circumstances is contingent on a disuse of the premises so long as the frost continues, and for at least one month or more thereafter. Even during the continuance of frost such places are dangerous, as the heat of the animal's body or of the rays of the sun at midday may suffice to set the virus free.

The following reports are submitted without further comment:

REPORT OF DR. H. J. DETMERS, V. S.

Hon. WM. G. LEDUC,
Commissioner of Agriculture:

SIR: Having been appointed by you as one of the inspectors to make an investigation of the diseases prevailing among swine, I forwarded to you my written acceptance, immediately after I received my appointment, on July 29, 1878, and took at once the necessary steps to obtain reliable information as to the localities where the disease of swine, known to the farmers as "hog-cholera," was at that time prevailing. I made also such other preparations as I deemed necessary to successful investigation, and provided myself with a good Hartnack microscope, divers chemicals and medicines, a clinical thermometer, &c. Among all the places and localities at which the disease, as reported, was very frequent, I selected Champaign, Champaign County, Illinois, as affording the greatest facilities for the intended investigation, or the most suitable basis for my operations, and repaired to that place on the second day of August. I found what I expected, *i. e.*, numerous cases of disease in the vicinity of Champaign and Urbana, and offers of assistance by F. W. Prentice, M. D., and M. R. C. V. S., who is lecturer on veterinary science in the Illinois Industrial University at Urbana, and of Prof. T. J. Burrill, M. A., who is professor of botany and microscopist in the same institution. Dr. Prentice had even the kindness of offering to me, for experimental purposes, the free use of his veterinary infirmary buildings. That offer, of course, was accepted. Besides that, Dr. Prentice, who is a very able and well-educated veterinary surgeon, has assisted me otherwise very essentially in my work, and took charge of my experimental animals whenever I was obliged to be absent for a short time. I am, therefore, very much indebted to him for his valuable help and kind assistance. Professor Burrill has assisted me in my microscopical examinations.

Arrived at Champaign I made my plans as to the manner in which to proceed with my investigation. Knowing that an enemy can only be conquered by being well known, I determined to ascertain first the real nature of the disease I had to deal with. That accomplished, I proposed to direct my attention exclusively to investigating and ascertaining the causes, reasoning that, if the causes are known, it cannot be very difficult to devise proper and efficient means of prevention, and, perhaps, remedies that will effect a cure. At any rate, a knowledge of the causes of a disease affords not only a sound, but in fact the only

basis of successful prevention and rational treatment. This plan I have executed as far as circumstances and the time granted have permitted me to do.

In order to become thoroughly acquainted with the nature of the so-called "hog-cholera," or more appropriately "swine-plague," called also typhoid, pig-typhoid, enteric fever, pneumo-enteric fever, hog or swine disease, &c., I have made during the time from August 2nd to November 1, 54 visits to 26 different herds of diseased swine, and 53 *post-mortem* examinations, and have examined microscopically the blood, diverse other fluids, morbid products, and tissues of 42 sick or dead animals.

For the purpose of ascertaining the cause or causes of the disease, I have also made numerous experiments, a detailed account of most of which will be found in this report. After having inquired into the causes, I have made other experiments in regard to prevention and treatment.

The following may be considered as the result of my investigations:

1. DESCRIPTION OF SWINE-PLAGUE.

The disease, commonly known as "hog-cholera" to the farmers, but which may, more appropriately, be called swine-plague—a name which I shall use exclusively hereafter—is a disease *sui generis*, peculiar to swine, is neither cholera nor anthrax; it somewhat resembles the enteric fever, or dothinenteria, of man, but is not identical with the same; is communicated from one animal to another by direct and indirect infection; has usually a subacute course; is extremely fatal, especially among young animals; and exempts neither sex, age, nor breed, but seems to prefer, in its attacks, for reasons hereafter to be explained, large herds, and is always most fatal in such sties, pens, and yards in which many animals are crowded together. Some individual animals seem to have more predisposition to the disease than others. The morbid process, although in all cases essentially the same, is not restricted to a single part or organ, or to a set of organs, but can have its seat almost everywhere—in the tissue of the lungs, in the pleura and pericardium, in the heart, in the lymphatic system, in the peritoneum, in all mucous membranes, especially in those of the intestines, in the liver, in the spleen, and even in the skin. Only the pulmonal tissue and the lymphatic glands are invariably affected.

2. THE SYMPTOMS.

The symptoms, although presenting certain characteristics, observed more or less in the affected animals, vary considerably in different cases, even in one and the same herd, but still more so in different herds, and in different seasons and localities. The causes of these differences will hereafter be fully explained.

To convey a better idea of the features of swine-plague, as presented in the living animal, I shall first give an outline of all the symptoms observed in a large number of hogs and pigs, and shall append, in order to show what combinations may occur in an individual animal, a description of the symptoms presented by some of my experimental pigs.

Swine-plague announces its presence very often by a cold shivering, lasting from a few minutes to several hours, frequent sneezing, and more or less coughing. The symptoms of shivering and sneezing are gen-

erally noticed. At the beginning of the disease the temperature of the body seems to be increased. The thermometer indicated from 104° to 106° F. Still, not much reliance can be placed on the temperature, as indicated by the thermometer. In some cases it was found to be very high—in one case as high as 111° F.—and in others below normal. It was always more or less variable, and has been found decreasing at the very height of the disease. I have come to the conclusion that in diseases of swine thermometry is of a very doubtful practical value, because to ascertain the temperature of a hog, that is not extremely low or in a dying condition, by introducing a thermometer into the rectum, requires the use of force, because a hog or pig can very seldom be persuaded to submit to that operation without struggling and without being held; and struggling, according to my observation, increases the temperature of such an irritable animal immediately. The general appearance of the animal, if correctly analyzed, is of much more diagnostic and prognostic value than the differences of temperature as indicated by the thermometer. In diseases of swine the latter is, at best, a nice and interesting plaything in the hands of the inexperienced.

The first symptoms are usually followed within a short time by a partial, and afterwards by a total loss of appetite; a rough and somewhat staring appearance of the coat of hair; a drooping of the ears (characteristic); loss of vivacity; attempts to vomit (in some cases); a tendency to root in the bedding, and to lie down in a dark and quiet corner; a dull look of the eyes, which not seldom become dim and injected; swelling of the head (observed in several cases); eruptions on the ears and on other parts of the body (quite frequent); bleeding from the nose (in a few cases); swelling of the eyelids, and partial or total blindness (in five or six cases); dizziness or apparent pressure upon the brain; accelerated and frequently laborious breathing; more or less constipation, or, in some cases, diarrhea; a gaunt appearance of the flanks; a pumping motion of the same at each breath; rapid emaciation; a vitiated appetite for dung, dirt, and saline substances; increased thirst (sometimes); accumulation of mucus in the canthi of the eyes (very often at an early stage of the disease); more or less copious discharges from the nose, &c. The peculiar offensive and fetid smell of the exhalations and of the excrements may be considered as characteristic of the disease. This odor is so penetrating as to announce the presence of the disease, especially if the herd of swine is a large one, at a distance of half a mile or even farther, provided the wind is favorable. If the animals are inclined to be costive, the dung is usually grayish or brownish black, and hard; if diarrhea is present the feces are semi-fluid, and of a grayish-green color, and contain, in some cases, an admixture of blood. In a large number of cases the more tender portions of the skin on the lower surface of the body, between the hind legs, behind the ears, and even on the nose and on the neck, exhibit numerous larger or smaller red spots, or (sometimes) a uniform redness (Red Soldier of the English). Toward a fatal termination of the disease this redness changes frequently to purple. A physical exploration of the thorax reveals, if pleuritis is existing, frequently a plain rubbing sound. As the morbid process progresses the movements of the sick animal become weaker and slower; the gait becomes staggering and undecided; the steps made are short, as if the animal was unable to advance its legs without pain; sometimes lameness, especially in a hind leg (not very often), and sometimes great weakness in the hind quarters, or partial paralysis (oftener) make their appearance. The head, if the animal is on its legs, seems to be too heavy to be carried, and is kept in

a drooping position with the nose almost touching the ground; but as a general rule the diseased animals are usually found lying down in a dark and quiet corner with the nose hid in the bedding. If a fatal termination is approaching, a very fetid diarrhea (usually one or two days before death) takes the place of the previous costiveness; the voice becomes very peculiar, grows very faint and hoarse; the sick animal manifests a great indifference to its surroundings, and to what is going on; emaciation and general debility increase very fast; the skin (especially if the disease has been of long duration) becomes wrinkled, hard, dry, parchment-like, and very unclean; a cold clammy sweat breaks out (observed several times, once as early as forty-eight hours before death), and death ensues either under convulsions (comparatively rare), or gradually and without any struggle. A peculiar symptom, which, however, has been observed only once, in a litter of nine pigs, about a week old, at the beginning, or in the first stage of the disease, may here be mentioned. It consisted in a peculiar and constant twitching of all voluntary muscles. All nine pigs died, and I am sorry that I had no opportunity to make any *post mortem* examination.

In some cases numerous eruptions (ulcerous nodules) appeared on the tender skin on the lower surface of the body between the legs and behind the ears, and in a few cases whole pieces of skin (in one case as large as a man's hand) were destroyed by the morbid process, sloughed off, and left behind a raw, ulcerous surface. In another case a part of the lower lip, of the gums, and of the lower jaw-bone had undergone ulcerous destruction.

Wherever pigs or hogs had been ringed, the wounds thus made showed a great tendency to ulcerate. In several cases the morbid process had caused sufficient ulcerous destruction to form an opening directly into the nasal cavities large enough to enable the animal to breathe through, instead of through the nostrils, which had become nearly closed by swelling and by exudations and morbid products adhering to their borders.

In those few cases in which the disease has not a fatal termination the symptoms gradually disappear, coughing becomes more frequent and easier; the discharges from the nose, for a day or two, become copious, but soon diminish, and finally cease altogether; appetite returns, and becomes normal; the offensive smell of the excrements disappears; sores or ulcers that may happen to exist show a tendency to heal; the animal becomes more lively, and gains, though slowly, in flesh and strength; but some difficulty of breathing, and a short, somewhat hoarse, hacking cough remains for a long time.

Symptoms of special cases.—Experimental pigs Nos. 5 and 6, both of the same litter, and about fifteen weeks old, were fed on the sixth day of September with the stomach, cut in pieces, the cæcum, and the spleen of experimental pig No. 2, which had died the same day.

September 7.—Pig No. 5 coughs a little but eats well; pig No. 6 has a slight catarrh; some yellow mucus in inner canthus of one eye.

September 8.—Both pigs the same as yesterday.

September 9.—Both pigs have very good appetite.

September 10.—Both pigs seem to be as well as possible; consume all their food greedily.

September 11.—Both pigs apparently healthy; neither one shows any symptoms of disease.

September 12.—Both pigs evidently sick; they are tardy in their movements; their ears are drooping; their appetite diminished. Pig No. 5 made attempts to vomit.

September 13.—Both pigs, but especially pig No. 5, are very sick; take scarcely any food; show a tendency to hide themselves in a corner; coat of hair looks rough and staring; flanks are thin; accumulation of mucus in the inner canthi of the eyes. No. 6 has discharges from the nose, especially from the right nostril.

September 14.—Pig No. 5, both eyes nearly closed; is weak, though not very; emaciates rapidly; appetite is poor. No. 6 has its eyes yet open; otherwise about the same as No. 5.

September 15.— Pig No. 5, eyes closed; is very loath to move, and shows plain symptoms of pneumonia. Pig No. 6, too, shows symptoms of pneumonia, but they are less pronounced; is without appetite, and just as much emaciated as No. 5. The skin of both animals is hard and dry; and their coat of hair rough and staring; their bowels are costive; but little dung is voided. Both animals betray plain indications of pain and suffering; neither one seems to be very thirsty.

September 16.—Pig No. 5 very weak, breathes one hundred times per minute; its flanks are working forcibly; slight lameness in left hind leg. Pig No. 6 is also very weak, but is yet able to run; passed a large quantity of urine of a bright yellow color. The appetite of both pigs for food is reduced to nothing, but both exhibit a vitiated appetite, and eat each other's dung, or their own, as soon almost as it drops. The skin is very hard to the touch, parchment-like, and seems to stick to the bones. In the evening pig No. 5 is extremely weak; is scarcely able to move; its breathing is difficult and distressing. No. 6 is about the same as in the morning.

September 17.—Pig No. 5 shows symptoms of dropsy in the chest, and breathes with great difficulty, about one hundred times per minute. In the evening the pumping motion of the flanks is increased, but the respiration is slower—about fifty-six breaths per minute. Pig No. 6 is a little more lively than No. 5, but also very sick, and has no appetite. Both pigs failed to void any dung from 8 o'clock a. m. to 6 o'clock p. m.

September 18.—Pig No. 5 exceedingly emaciated, some rattling noise in the respiratory passages. Pig No. 6 about the same as yesterday.

September 19.—Pig No. 5 emaciated to the utmost, but otherwise apparently not worse Pig No. 6 shows apparent improvement; is a little livelier than before; has some appetite; consumed one ear of corn during the last twenty-four hours. In the evening pig No. 5 breathes with the greatest difficulty, one hundred and four times per minute. No. 6 unchanged.

September 20.—Pig No. 5 very sick; breathes with great difficulty. No. 6 apparently improving.

September 21.—Pig No. 5 just alive. Both pigs have been lying nearly all day in one corner of their sty, their noses buried in the bedding. In the evening pig No. 5 is perspiring; sweat cold and clammy.

September 22.—Pig No. 5 breathes sixty-four times per minute, with jerking motions of the flanks, and so far has been more or less constipated, but now has diarrhea; feces grayish-green, semi-fluid, and exceedingly fetid. Pig No. 6 is less emaciated than No. 5, has no diarrhea, and eats a little. Urine of No. 5, examined under the microscope, contained innumerable bacillus-germs (micrococci of Hallier), and a few *bacilli suis.** (See drawing I, fig. 1.)

September 23.—Pig No. 5 a mere skeleton, and extremely weak; breathes only forty-eight times per minute. Pig No. 6 not quite so low; breathes only thirty-six times per minute. In afternoon pig No. 5 too weak to stand on its legs; breathes fifty-two times per minute; is sweating; the sweat cold and clammy. Seeing that the animal could not possibly live till next morning, and desiring to make the *post mortem* examination before putrefaction should set in, I killed pig No. 5 by bleeding at 6 o'clock p. m. (As to result of *post mortem* examination, see chapter on Morbid Changes.)

September 24.—Pig No. 6 very sick; eats scarcely anything.

September 25.—Pig No. 6 shows slightly increased appetite, and fully as much, if not more, liveliness than on any day last week. It almost seems as if some real improvement is going on, notwithstanding very serious morbid changes must have taken place.

September 26.—Pig No. 6 eats some in the morning, but does not seem to care for any food at noon; appears to be a trifle bloated; droops its head, and holds its nose to the ground.

September 27.—Pig No. 6 decidedly worse; breathes seventy-two times per minute; head drooping; nose to the ground; back arched; skin very dry and hard to the touch; no appetite whatever.

September 28.—Pig No. 6, which was very low last night, has somewhat recuperated, and is moving again; consumed some water, and also a little food.

September 29.—Pig No. 6 exceedingly emaciated and very weak; breathes thirty-eight times per minute; holds its nose persistently to the ground, and has no appetite whatever.

September 30.—Found pig No. 6, at 7 o'clock a. m., lying dead in a corner of its sty. (See chapter on Morbid Changes as to result of *post mortem* examination.)

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*I have chosen the name "*bacillus suis*" because the *bacilli*, as will appear hereafter, seem to be peculiar to swine-plague, and have not been before named as far as I have been able to learn.

It may be well to add a brief account of the symptoms and the progress of the disease, as observed in experimental pig B, a sow pig, about fourteen weeks old, and of mixed Poland China and Berkshire stock. Pig B was put in pen No. 3, together with pig No. 6, on September 24. The same was and remained perfectly healthy until October 2, when the first symptoms of disease made their appearance. I find in my diary the following notes:

October 2.—Pig B shows symptoms of sickness; sneezes; has an eruption on both ears; is not quite as lively as it used to be; appetite is diminished; curl is out of its tail.

October 3.—Pig B has but little appetite; is decidedly sick. In afternoon shows unmistakable symptoms of sickness; ears are drooping; no appetite; great tendency to lie down in a corner; hides its nose in the bedding.

October 4.—Pig B about the same as yesterday; has eaten a little.

October 5.—Pig B hides its nose in the bedding; has no appetite whatever; emaciation has taken place. B, although a week ago a better and heavier pig than C, a full sister, and of the same litter, is now considerably lighter.

October 7.—Pig B very sick; still, seems to have a desire to eat, but takes hold of an ear of corn so feebly as to make it appear that it has not sufficient strength in the jaws to shell the corn; gave it, therefore, shelled.

October 8.—Pig B very sick; hides in its corner; ears are cold; other parts of the body warm; no appetite; great indifference to surroundings; emaciation rapid.

October 9.—Pig B about the same as yesterday.

October 10.—Pig B is getting worse; does not eat anything.

October 11.—Pig B found dead in its pen in the morning.

These three cases show that the symptoms vary in different cases, and that those which are constant can scarcely be considered as very characteristic. Still, if the various symptoms presented by an individual animal are taken as a whole, a diagnostic mistake is scarcely possible.

The diagnosis is very easy, especially if swine-plague is known to be prevailing in the neighborhood, or has already made its appearance in the herd, and if the anamnesis, and the fact that many animals are attacked at once, or within a short time and in rapid succession, are taken into consideration. As symptoms of special diagnostic value, scarcely ever absent in any case, may be mentioned the drooping of the ears and of the head; more or less coughing; the dull look of the eyes; the staring appearance of the coat of hair; the partial or total want of appetite for food; the vitiated appetite for excrements; the rapid emaciation; the great debility; the weak and undecided, frequently staggering, gait; the great indifference to surroundings; the tendency to lie down in a dark corner, and to hide the nose, or even the whole head in the bedding, and particularly the specific, offensive smell, and the peculiar color of the excrements. This symptom is always present, at least in an advanced stage of the disease, no matter whether constipation or diarrhea is existing. As other characteristic symptoms, though not present in every animal, deserve to be mentioned: frequent sneezing; bleeding from the nose; swelling of the eyelids; accumulation of mucus in the inner canthi of the eyes; attempts to vomit, or real vomiting; accelerated and difficult breathing; thumping or spasmodic contraction of the abdominal muscles (flanks) at each breath, and a peculiar, faint and hoarse voice in the last stages of the disease.

3. THE PROGNOSIS AND TERMINATION.

The prognosis is decidedly unfavorable, but is the more so the younger the animals or the larger the herd. Among pigs less than three months old the mortality may be set down as from 90 to 100 per cent.; among animals from three to six or seven months old the same is from 75 to 90 per cent.; while among older animals that have been well kept and are

in good condition, and naturally strong and vigorous, the mortality sometimes may not exceed 25 per cent., but may, on an average, reach 40 to 50 per cent. The prognosis is comparatively favorable only in those few cases in which the morbid process is not very violent; in which the seat of the disease is confined to the respiratory organs and to the skin; in which any thumping or pumping motion of the flanks is absent; and in which the patient is, naturally, a strong, vigorous animal, not too young and in a good condition; further, in which but a few, not more than two or three, animals are kept in the same pen or sty, and receive nothing but clean uncontaminated food and pure water for drinking, and in which a frequent and thorough cleaning of the sty or pen prevents any consumption of excrements.

The duration of the disease varies according to the violence and the seat of the morbid process, the age and the constitution of the patient, and the treatment and keeping in general. Where the morbid process is violent, where its principal seat is in one of the most vital organs—in the heart, for instance—where a large number of animals are kept together in one sty or pen, where sties and pens are very dirty, or where the sick animals are very young, the disease frequently becomes fatal in a day or two, and sometimes even within twenty-four hours. On the other hand, where the morbid process is not very violent or extensive, where the heart, for instance, is not seriously affected, and where the patients are naturally strong and vigorous, and well kept in every respect, it usually takes from one to three weeks to cause death. If the termination is not a fatal one, the convalescence, at any rate, requires an equal and probably a much longer time. A perfect recovery seldom occurs; in most cases some lasting disorders—morbid changes which can be repaired but slowly or not at all—remain behind, and interfere more or less with the growth and fattening of the animal.

From a pecuniary standpoint, it makes but little difference to the owner whether a pig affected with this plague recovers or dies, because those which do survive usually make very poor returns for the food consumed, unless the attack has been a very mild one.

4. MORBID CHANGES.

The morbid process, although everywhere essentially the same (see chapter on Contagion, Causes, and Nature of Morbid Process), can have its seat in many different organs or parts of the body, and produces, therefore, a great variety of morbid changes. The disease, in consequence, very often presents a somewhat different aspect in different animals. In some cases the principal seat of the morbid process is in one organ or set of organs (organs of respiration and circulation, for instance), and in others in entirely different parts (intestinal canal and organs of digestion, &c.) Death, therefore, has very often a different cause in different cases; in some cases it results from a cessation of the functions of the heart, the lungs, &c., and in others it is in consequence of the inability of entirely different organs to perform their functions,—of the digestive apparatus, for instance.

But few morbid changes have ever been found entirely absent at any of the fifty-three *post-mortem* examinations made since August 2, and may, therefore, be considered as a constant occurrence. All others have been found absent a larger or smaller number of times. These constant morbid changes consist—

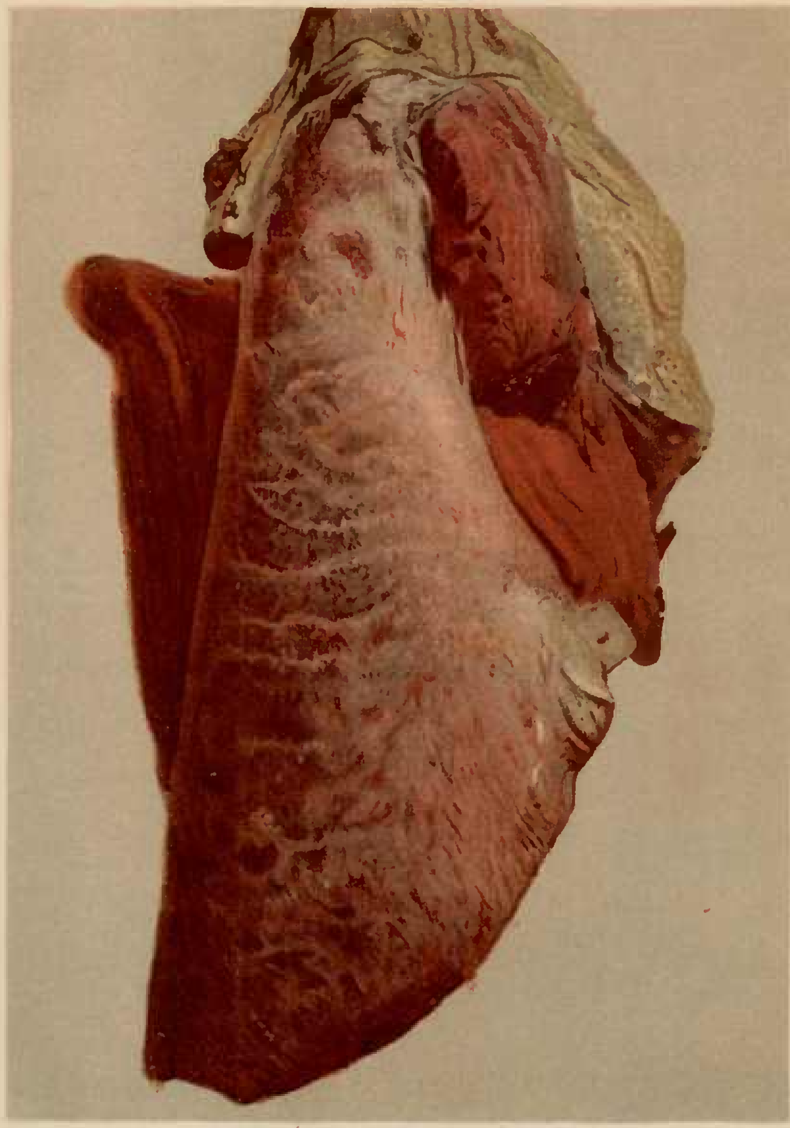
1. In a more or less perfect hepatization of a larger or smaller portion of the lungs, or a more or less extensive accumulation of blood, blood-

serum and exudation in the pulmonal tissue. In some cases the morbid changes (hepatization) found in the lungs are so extensive as to cause the latter, if thrown into water, to sink like a rock, but in other cases the hepatization is limited to about one-sixth or one-eighth of the whole pulmonal tissue. In some cases, especially those in which the morbid changes were of a recent origin, no real hepatization, fully developed, had yet been effected; the lungs were merely gorged with exudation or blood-serum; the texture was not yet destroyed or seriously changed, but innumerable small red spots or specks, indicating incipient embolism, were plainly visible to the naked eye. (See photograph, Plate I, half-size lungs, right side of experimental pig No. VII, and photograph, Plate II, enlarged section of same lungs.) In other cases a part of the exudation had changed, organized, or become a part of the tissue, and had caused the latter to become more or less perfectly impermeable to air. In some lungs hepatization was found only in certain insulated places, while in others the hepatization extended uninterruptedly over whole portions. In all these cases in which the hepatization was very limited, it was found principally in the anterior lobes. In some animals (that is in those which had been sick for some time), old or so-called gray, more recent or brown, and very new or red hepatization were frequently found side by side, or in more or less distinctly limited patches, showing plainly that the morbid changes had not been produced at once, but at several intervals. In others, usually the upper parts of the same lungs, the exudation or blood-serum had been recently deposited, and was yet in a fluid condition. The blood-serum, examined under the microscope, invariably contained, besides blood-corpuscles, numerous *bacilli suis*, some moving and some without motion, and innumerable bacillus-germs, of which some had budded, some were budding, and others had conglomerated. (See drawing II, figs. 3 and 4, and drawing III, fig. 1.)

2. The lymphatic and mesenteric glands were found invariably more or less enlarged. In some cases they presented even a brownish or blackish color, and contained not only deleterious matter, but even effusions of blood in sufficient quantities to push aside the normal glandular tissue. Whether neoplastic formations (a proliferous growth of cells) had taken place I have not ascertained, but have not the least doubt that it had. Under the microscope, particles of lymph and glandular substance, taken from the interior of the lymphatic gland, presented, besides normal tissue and lymph-corpuscles, a few blood-corpuscles, some granular detritus, and innumerable *bacilli* and bacillus-germs. (See drawings III and IV, figs. 5 and 3.) As lymphatic glands always most conspicuously enlarged and morbidly changed, may be mentioned the superficial and deep inguinal and the axillary glands, the bronchial and mediastinum glands in the chest, and the mesenteric, gastric, gastro-epiploic, and hepatic glands in the abdominal cavity.

3. The trachea and the bronchial tubes contained in all cases more or less of a frothy mucus—in some cases the bronchial tubes were full of it—which consisted, examined under the microscope, of broken-down epithelium-cells, and contained a large number of bacillus-germs and *bacilli*. (See drawing III, fig. 2.) The mucous membrane of the trachea and of the bronchial tubes appeared to be congested, and more or less swelled in every case.

4. The pulmonal and costal pleura, the mediastinum, and the pericardium presented almost invariably some morbid changes; only in a few cases no visible morbid changes could be found. In some animals those membranes appeared to be smooth, but either the thoracic cavity or the pericardium, usually both, contained a smaller or larger quantity (from



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Half size of right lung of experimental pig, No. VII.

one ounce to one pint or more) of straw-colored serum. In a great many cases one or more, and sometimes all, of those membranes were coated to some extent with plastic exudation. In several cases a more or less firm adhesion between costal and pulmonal pleura and mediastinum, between pulmonal pleura and diaphragm, or between pulmonal pleura and pericardium, had been effected. In a few cases the whole surface of the lungs appeared more or less firmly united with the walls of the thorax. In one case the whole external surface of the heart was firmly, and in another one partially, coalesced with the inner surface of the pericardium. The pig (a fine animal about four months old), in which the pericardium adhered with its whole interior surface firmly and inseparably to the external surface of the heart, had severe convulsions during life. It was killed in my presence by a professional butcher, who stuck it in the usual way and severed the trunk of the carotids; only a few drops of blood issued, but the pig died immediately. The other morbid changes consisted in hepatization in the lungs, enlargement of the lymphatic glands, and the presence of large and numerous morbid growths in the cæcum and colon.

5. In nearly every animal the heart itself has been found more or less affected in one way or another. In some animals it was flabby and dilated, but in most cases it was more or less congested. The capillary vessels, especially of the auricles, were, in a large number of cases, gorged with blood to such an extent as to give them a brownish-black appearance, almost similar to gangrene. On closer inspection, however, it could be seen very plainly that the brownish-black color was caused exclusively by an accumulation of blood in the capillary vessels.

6. In forty-eight cases out of fifty-three, characteristic morbid changes have been found in the cæcum and colon. The same consist in peculiar morbid growths or ulcerous tumors on the mucous membrane of those intestines. They are of various sizes, nearly round or (sometimes) irregular in shape, more or less elevated above the surface of the mucous membrane, and frequently, especially the older and larger ones, dark-pigmented on their surface. Their size varies from that of a pin's head (incipient tumors or nodules) to that of a quarter of a dollar. The smaller ones are usually of an ocher color, and but slightly projecting above the surface of the mucous membrane (see photograph, Plate III), but the larger ones are of a grayish-black-brown (see photograph, Plate IV,) or blackish color; project considerably above the surface of the membrane, in some cases fully half an inch; have usually a slight concavity in the center, and frequently a plain neck or thick pedicle. (See photographs, Plates V, VI, and VII.) Under the microscope these morbid growths or excrescences appear to be composed, on their surface, of a granular detritus and morbid epithelium cells, and contain innumerable *bacilli suis*, some of which have a very rapid motion. (See drawing V, fig. 1.) The stroma of these morbid growths consists mainly of a dense connective tissue. In some cases these morbid growths, especially the smaller ones, or those of a recent origin (see photograph, Plate III), are situated merely on the surface of the mucous membrane, and are easily scraped off with the back of the scalpel. Thus removed they leave behind an uneven, excoriated surface, not dissimilar to granulation. The older and larger tumors, however, extend deeper into the membranes of the intestine; they usually penetrate the mucous membrane, and extend into the muscular coat, and even penetrate the latter, and extend into the external or serous membrane. In some cases all three membranes of the cæcum or colon have been found degenerated and destroyed beneath such a morbid growth, so as to show perforation

on the removal of the latter. The immediate surrounding of such a deep-seated degeneration presented some, but not very much, inflammation. These morbid growths, usually, were found most developed near the ileo-cæcal valve in the cæcum, but also in larger or smaller numbers, and of various sizes, large and small, in all parts of the cæcum and colon.

7. The same, or very similar morbid growths, occurred also, though not so often, in other intestines. In one case (experimental pig No. VII) a diffuse, decaying morbid growth coated the whole interior surface of the jejunum for a length of several feet. Examined under the microscope it was found to consist of broken-down epithelium cells and a granular detritus, and contained numerous *bacilli* and bacillus-germs. (See drawing VI, fig. 1.)

In another case one ulcerous tumor was found on the mucous membrane of the gall-bladder. In three cases the same, or at least very similar morbid changes, presented themselves on the mucous membrane of the stomach. (See photograph, Plate VIII.) In a few cases some ulcerous tumors were found in the duodenum, and in one case even in the right horn of the uterus. In a few cases similar morbid changes—small, knotty, tubercle-like, yellowish, or ocher-colored excrescences of the size of a small pea—were found on the surface of the spleen. In one case similar small excrescences were also found on the external surface of the vena cava posterior. In two cases the liver was found to be degenerated by an hypertrophic condition of the connective tissue, a morbid change which may or may not constitute a product of the morbid process of swine-plague.

8. Morbid changes in the serous membranes of the abdominal cavity. In some cases the peritoneum and the serous membranes of the intestines appeared to be perfectly smooth, but a larger or smaller quantity of straw-colored serum, from two ounces to one quart or more, was found in the abdominal cavity. In others, adhesions between the intestines and the peritoneum, between the intestines themselves, or with other organs, had been effected. More or less coalescence between cæcum and colon, between cæcum and ilium, or between the convolutes of the colon, sometimes not separable except by means of the knife, presented itself in almost every case, in which the ulcerous tumors or morbid growths in the cæcum and colon were extensive, large, and sufficiently deep-seated to affect the serous membrane.

9. The contents of the gall-bladder in a large number of cases were found to consist of a semi-solid, granular, and dirty brownish-colored substance. In most of those cases, however, the ductus choledochus appeared to be thickened, and its membranes swelled; and so it may be that the semi-solid condition of the bile was due, to some extent, to the partially or totally obstructed passage.

10. In one case a morbid enlargement or hypertrophy of the pancreas presented itself, and slight changes (congestion) were found in a few cases in the kidneys.

11. Morbid changes, similar in every respect to those occurring on the mucous membrane of the cæcum and colon, presented themselves in two cases on the conjunctiva, or mucous membrane of the eye. But as the conjunctiva is exposed more or less to the influence of the atmosphere, the morbid growth was not projecting in the same way as in the cæcum and colon above the surface of the membrane; the decay was more complete, and, perhaps, more rapid, so that instead of an excessive growth loss of tissue could be noticed. In both cases the eyes themselves appeared congested, and the animals seemed to be perfectly blind.

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Enlarged section of right lung of experimental pig No.VII

12. In one case the gums of the lower jaw presented similar changes, but in these, too, considerable loss of tissue had taken place. The morbid process extended into the lower jaw-bone, and enough of it had been decayed and destroyed to expose the roots of the incisors, and to cause some of them to drop out.

13. Morbid changes, ulceration, and decay have been observed twice in one of the spermatic chords of pigs which had been castrated a short time before the disease was contracted. In both pigs an abscess was found in the scrotum, the only instance in which real matter or pus was observed.

14. In nearly all those hogs and pigs which had been ringed to prevent them from rooting, the parts thus wounded presented more or less decay, in about a dozen cases to such an extent as to cause a formation of large holes directly from the superior surface of the nose into the nasal cavities. These holes presented very ragged or corroded borders, coated with a dirty-yellowish detritus, and were, in several instances, sufficiently large to enable the animals to breathe through, instead of through the nostrils.

15. Morbid changes in the skin, but of a different character, were found to be of frequent occurrence. In three or four cases numerous small morbid growths (eruptions) extending but slightly into the cutis, but causing a complete degeneration of the epidermis, and leaving behind, if removed, an uneven, raw, or excoriated surface, in appearance not unlike granulation, were found on the comparatively fine skin on the lower surface of the body, between the legs and behind the ears. In two other cases whole pieces of degenerated and decayed skin had sloughed off and fallen out. The corroded borders and the bottom of the ulcers, thus produced, were coated with a dirty-yellowish looking granular detritus.

In a great many cases, that is, in nearly half of the whole number examined, red or purple spots and patches, and even continuous or confluent redness, of a purple hue, presented themselves in the skin on the lower surface of the body, between the legs, behind the ears, &c. At the autopsy the skin and the subcutaneous tissue appeared to be congested, the capillary vessels were gorged with blood, and more or less exudation and small extravasations of blood were found to have taken place. In one case a large piece of skin on the lower surface of the body was mortified.

16. In two cases quite extensive extravasations of blood presented themselves in the mucous membrane of the stomach and intestines.

17. The blood presented some quantitative and qualitative changes in every case. Its quantity appeared to be diminished in every animal, in some cases to such an extent that not more than, say, four or five ounces could have been collected if the animal had been killed by bleeding. Still, the actual want of blood was never as great as it appeared to be, because a considerable quantity was locked up in the tissues, especially in the lungs, and had become stagnant in the capillary vessels. The blood was dark-colored in all cases in which death had been caused by extensive morbid changes in the lungs, or in which, on account of those changes, respiration had been very imperfect; but it presented a normal color, and was perhaps a little lighter colored and thinner or more watery than in a healthy hog, in all cases in which death had been caused by other morbid changes, or in which the affection of the lungs was comparatively unimportant. It invariably coagulated as soon as it became exposed to the influence of the atmosphere, to a loose and spongy clot, containing a considerable quantity of serum.

Hence, it must be supposed that it was rich in fibrinogen, but probably poor in fibrin, a condition due, unquestionably, to the fact that during the disease the process of waste had been largely in excess of that of repair.

Under the microscope the blood-corpuscles of fresh blood appeared sometimes nearly all normal or round, and sometimes more or less angular and star-shaped, but after a while they all became more or less angular and of an irregular shape, and showed more or less tendency to congregate in rows and clusters. The fresh blood contained numerous bacillus-germs, many of them simple, small, round bodies, some in process of budding, others budded or double, and still others congregated into, apparently, viscous clusters. (See drawing II, fig. 1; drawing IV, fig. 4; drawing VII, figs. 1 and 4; drawings VIII, IX, and X, fig. 1.) In a few cases fully developed *bacilli suis* were found in the fresh blood, but they were, comparatively, few in number. In blood which had been kept twenty-four hours or longer in well-closed vials, *bacilli* were always more numerous, and sometimes were found in large numbers. As soon, however, as putrefaction or decomposition had set in, the *bacilli* disappeared. White blood-corpuscles, a few in number, were found only in three or four cases.

18. A microscopic examination of the blood-serum or exudations, deposited in the pulmonal tissue, invariably revealed, besides some angular red blood-corpuscles, an immense number of *bacilli suis*, and of bacillus-germs in all stages of development, single, budding, budded, or double, and congregated into clusters. (See drawing III, fig. 1, and drawing II, figs. 3 and 4.)

That every one of these morbid changes does not occur in one and the same animal, and that sometimes some and sometimes others are more developed and constitute the immediate cause of death, has already been indicated, and does not need any further explanation. To convey, however, a clearer idea of the morbid features and changes presented after death, I will copy from my notes the result of the *post-mortem* examinations of a few of my experimental pigs. Of pigs Nos. 5 and 6 the symptoms, observed during life, have already been noted.

Post-mortem examination of pig No. 5.—On opening the chest, the ribs, usually tough in a young animal, broke very easily, and seemed to be deficient in organic substances. No serum in the chest; pulmonal pleura rough, partially coated with plastic exudation; lower half of both lobes of lungs hepatized; no serum in the pericardium, but apex of heart firmly coalesced with the inner surface of the pericardium; thick, white, and frothy mucus, but no *strongili paradoxi* in trachea and bronchial tubes. Cæcum and colon firmly agglutinated to each other with their external surfaces; adhesion separable only by means of the knife. Numerous large and small ulcerous tumors or morbid growths in both cæcum and colon. (See photograph, Plate V, which shows the cæcum, and Plate VI, which shows the colon, natural size of pig No. 5.) Lymphatic and mesenteric glands enlarged. Ulcerous decay in mucous membrane of the stomach. (See photograph, Plate VIII, which presents the interior surface of the stomach of pig No. 5, natural size.) Besides those essential changes mentioned, one large nematoid was found in the ductus choledochus, extending from the duodenum through the choledochus and the gall-bladder into an hepatic duct. Another worm of the same kind was found in the cæcum.

Autopsy of pig No. 6.—An abscess in right side of the scrotum, about seven-eighths of an inch in diameter, and connected with ulceration in right spermatic chord. Inguinal and axillary lymphatic glands

SWINE FEVER

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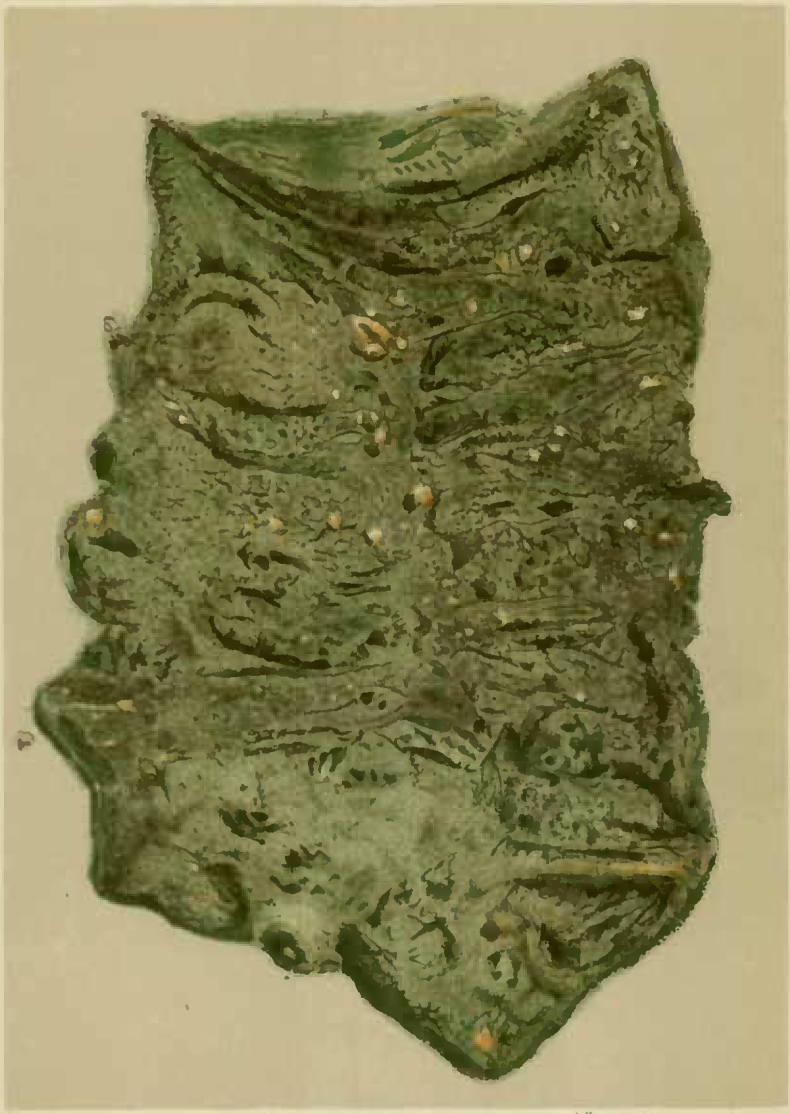
Plate III



Ulcerous tumors on mucous membrane of intestines

considerably enlarged. One-fourth of right and one-fifth of left lobe of lungs hepatized; the rest gorged with blood-serum or exudation. Cæcum and colon agglutinated to each other; cæcum also adhering to peritoneum. Mesenteric glands very much enlarged; right spermatic chord ulcerated. (Pig had been castrated a few weeks before it contracted the disease.) Extensive morbid growth, in process of decay, in cæcum, and also a large number in colon. Some exudation on lower surface of spleen. Ulcerous decay in mucous membrane of anterior portion of stomach, and wine-colored infiltration and extravasations of blood in mucous membrane of pyloric portion of same intestine.

Autopsy of pig B.—Some redness between hind legs and on lower surface of the body; greenish mucus oozing from the nose; axillary and inguinal glands very much enlarged; ribs deficient in organic substances, at any rate very brittle; both lungs spotted all over, indicating plainly capillary embolism in early stage of development; hepatization limited, just commencing; lymphatic glands in chest very much enlarged; the heart, but especially the auricles, very much congested; auricles almost black; small quantity of straw-colored serum (not exceeding two ounces) in thoracic cavity, and still less in pericardium. In the abdominal cavity mucous membrane of anterior part of stomach wine-colored; some diffuse morbid growth, in process of decay, in posterior (pyloric) portion of same membrane. No food whatever in stomach and intestines; bile thickened, semi-solid; no ulceration nor any morbid growth whatever in cæcum, colon, or any other intestine.

Results of post-mortem examination of experimental pig No. VI.—Decaying blotches or nodules of the size of a five-cent piece and smaller on skin of lower surface of body and between the legs; right spermatic chord ulcerated, and an abscess the size of a hen's egg in right side of scrotum. Internally all lymphatic and mesenteric glands enlarged; anterior portion of both lungs everywhere, with their whole external surface, and posterior portion at some places adhering (coalesced) to the costal pleura; numerous smaller and larger embolic tubercles, presenting the appearance of incipient abscesses, in anterior portion of both lobes of the lungs, but more numerous and more developed in right lobe than in the left; remainder—posterior parts of both lobes—gorged with exudation; small quantity of straw-colored serum in the chest and in the pericardium. In abdominal cavity, liver rather hard (sclerotic), its connective tissue apparently hypertrophied. One small tape-worm, not over one and a half inches long, in jejunum, and numerous small, incipient morbid growths or ocher-colored decaying nodules in cæcum. (See photograph, Plate III.) No other morbid changes.

Besides these numerous morbid changes, which must be looked upon as products of the morbid process of swine-plague, some species of entozoa, a few of which have already been mentioned, have occasionally been met with; but as their presence is merely accidental, that is, has nothing whatever to do with the disease in question, a brief mention of this occurrence will be sufficient. *Strongylus paradoxus* has been found in small numbers in the bronchial tubes of a few pigs in one herd only—Mr. Bassett's. *Trichocephalus crenatus* (whip-worm) has been found in small numbers in the blind end of the cæcum of four animals, belonging to two different herds. A small tape-worm was once found in the jejunum, as has been stated, and a few other entozoa (nematoids) were found in four or five instances in the choledochus, gall-bladder, and hepatic ducts (in one case as many as twelve worms), and twice in other intestines.

What I have so far related was comparatively easily ascertained. Nu-

merous examinations of diseased animals, frequent visits to affected herds, and fifty-three *post-mortem* examinations revealed the facts, and all that was necessary was to observe and take notes. But the principal object of the investigation was to devise means to prevent the immense losses caused every year by that most fatal disease, swine-plague. (I have adopted that name, because the disease, if anything, is a real plague; and the name is sufficiently comprehensive to cover the whole morbid process, and so simple that I have no doubt it will soon supercede, even among farmers, that very improper name of hog cholera.)

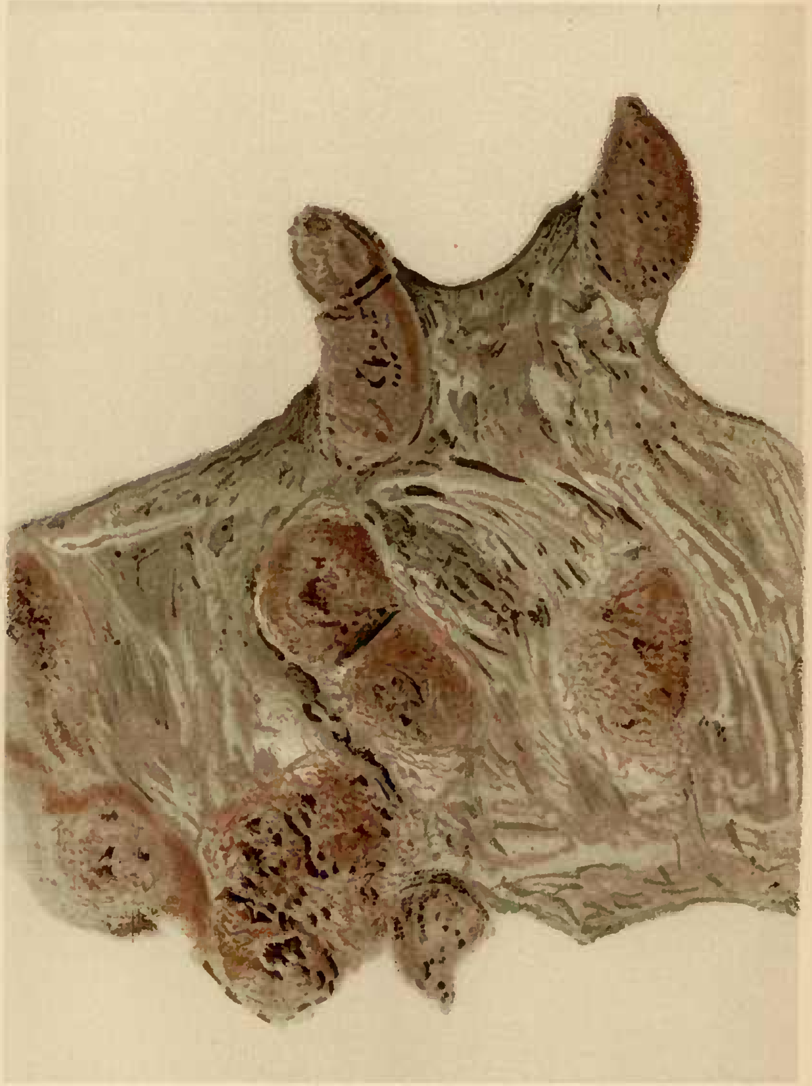
To devise such means, a more reliable basis than a mere knowledge of the various features of the disease had to be gained. The real nature of the morbid process, and the true cause or causes, had to be ascertained. Above all, it had to be decided as to whether swine-plague is a contagious disease or not; and if contagious, the means by which the contagion is conveyed from one place and from one animal to another; the manner in which it enters the animal organism, and, if possible, the nature of the same. This could not be done by simply visiting diseased herds and examining sick and dead animals; it was necessary to make experiments and to observe and to record the results. This I have done, and before I proceed any further it may be best to give, first, a condensed account of the experiments which I have made for the purpose of settling those points, so as to give others an opportunity to form an opinion as to the correctness of the conclusions I have arrived at. I will mention again, that in making those experiments, in noting the results, and in making the necessary and very numerous microscopical examinations, I have been ably assisted by my friends, Dr. F. W. Prentice and Prof. T. J. Burrill, of the Illinois Industrial University. I commenced those experiments after I had gained considerable information as to the various features of the disease during life and after death, and as to the conditions and surroundings under which the same makes its appearance. The first series of experiments has been made for the purpose of settling the question as to the contagiousness or non-contagiousness of Swine-Plague. This was the more necessary from the fact that those who had suffered severe losses were decidedly divided on that question.

FIRST SERIES OF EXPERIMENTS.

After encountering considerable difficulty in finding indubitably healthy pigs, belonging to a perfectly healthy herd, which had never been in contact with diseased animals, I succeeded finally, on the 20th of August, in buying of Mr. Harris, south of Champaign, three Berkshire sow pigs about three and a half months old, perfectly healthy, and without any lesions whatever. I designated them as pigs Nos. 1, 2, and 3. Dr. Prentice, at the same time, had the kindness of placing at my disposition two box-stalls in his veterinary hospital, a new building which had never been entered by any hog or pig. About one hundred and fifty yards east of the veterinary hospital building, on a piece of ground never trodden by hogs, as far as known, I built of new lumber a pen eight feet square. This pen I designated pen No. 1, and the box-stalls, which are twelve feet square, as pens Nos. 2 and 3 respectively. Pig No. 1 was put in pen No. 1, and pigs Nos. 2 and 3 together in pen No. 2.

It may be well to state here that pen No. 1 having no floor, but resting on the ground, was moved to another place (each time its own width) every other day, usually at noon, in order to preserve cleanliness, and pens Nos. 2 and 3 were cleaned and swept once a day, except where

SWINE FEVER



A. Hoen & Co. Lithocaustic, Baltimore.

Ulcerous tumors on mucous membrane of intestines, projecting above surface.

stated otherwise in the following pages. The food of all experimental pigs was the same, and consisted of corn in the ear, and occasionally a little green clover and purslane at noon or in the evening. The water for drinking was drawn three times a day from a well.

Account of pig No. 1.—On August 21 I procured from Mr. Bassett, four miles north of Champaign, a diseased Chester White pig, four months old (pig No. 4), which I put with pig No. 1 in pen No. 1. This diseased pig, which arrived at 10.30 o'clock a. m., exhibited plain and unmistakable symptoms of swine-plague; its temperature was 106½° F., and its skin, on lower surface of the body, between the legs, &c., was considerably reddened. The temperature of pig No. 1, which objected to being examined and struggled hard, was 104½° F.

August 22.—Pig No. 1 all right; has vigorous appetite. Pig No. 4 at 8 o'clock a. m. very sick; has a peculiar, short, abrupt cough; at 1 o'clock p. m., dead.

Post-mortem examination.—Capillary redness in the skin on lower surface of body and between the legs; considerable enlargement of lymphatic glands; more than two-thirds of the lungs hepatized and gorged with blood-serum; some straw-colored serum in thoracic cavity and pericardium; and morbid growths in process of decay (ulcerons tumors) in cæcum and colon.

Received at 1 o'clock p. m. three more pigs, each about three months old (cross of Berkshire and scrub), of Mr. Schumacher, a butcher in Champaign, who had bought the same of a farmer ten miles southeast of Champaign. I designated the same as pigs Nos. 5, 6, and 7. Pigs Nos. 5 and 6 appeared to be perfectly healthy, and were put together in pen No. 3. Pig No. 7 was apparently indisposed; it had been transported ten miles, crowded together with twenty others, most of them larger and older, and exposed for several hours to the burning rays of the sun, in an open farm-wagon, on a very hot day. It was panting for breath, and showed symptoms of congestion of the lungs. It was put in pen No. 1 with pig No. 1, before dead pig No. 4 had been removed.

August 23.—Pig No. 1 perfectly healthly. Pig No. 7 very sick; breathes ninety-two times per minute; shows plain symptoms of pleurites; has no appetite, but is attentive and moves quickly when disturbed. It died at 8 o'clock p. m. *Post-mortem* examination revealed pleurites and pericarditis; the whole surface of the lungs was loosely agglutinated to costal pleura, and the substance of the same was gorged with exudation. *No other morbid changes whatever.* Whether this was a case of swine-plague or not, I leave to my readers to decide for themselves. I am decidedly of the opinion it was not, because none of the other twenty pigs, except Nos. 5 and 6 (see account of them) have, up to date,, contracted the disease, as I have learned from a reliable source. It is true two other pigs of the same lot showed some indisposition on the 24th, 25th, and 26th days of August, but were all right again the next day, and are healthy yet.

August 24.—Pig No. 1 perfectly healthy; vigorous appetite.

August 25 to 27:—No change.

August 28.—Weather very hot and sultry; in afternoon severe thunder-storm and rain, which effected a sudden cooling of the atmosphere. Pig No. 1 in perfect health.

August 29.—Pig No. 1 coughed once; being exposed in an open pen to the changes of weather and temperature, it has possibly taken cold.

August 30.—Pig No. 1 perfectly healthy; is very lively, and has vigorous appetite.

August 31 to *September* 4.—The same.

September 4.—The same. At 6.30 o'clock p. m., diseased experimental pig No. 2 (see account of the same further down) was put in pen No. 1 with pig No. 1.

September 5.—Pig No. 1 perfectly healthy. Pig No. 2 eats nothing; shows plain symptoms of pneumonia.

September 6.—Pig No. 1 perfectly healthy. Pig No. 2 died at 6 o'clock p. m. (For *post-mortem* examination, which was made immediately, see account of pig No. 2.)

September 7.—Pig No. 1 perfectly healthy, and has remained so up to date. Has always first-rate appetite, has never refused a meal, and is to-day a strong, vigorous, and thriving pig. (Made use of the same for another experiment on *November* 13.)

2. *Account of pigs Nos.* 2 *and* 3.—*August* 21.—Both pigs are perfectly healthy; have good appetite, and are active and lively.

August 22.—Both pigs perfectly healthy. Inoculated both in right ear at 1.30 o'clock p. m. with blood-serum from the lungs of pig No. 4, which had died at 1 o'clock p. m. The operation was performed by means of a small inoculation-needle, made for the purpose of inoculating sheep with the virus of sheep-pox. Each pig received two slight punctures on the external surface of the ear; the serum inoculated was less than one-fourth of a drop per animal. The blood-serum used was of a faint reddish color, and almost limpid. Examined under the microscope it contained a few red blood-corpuscles, numerous bacillus-germs, and some developed *bacilli suis.*

August 23.—Pigs Nos. 2 and 3 perfectly healthy. No visible reaction.

August 24.—Both pigs perfectly healthy; have very good appetite.

August 25 and 26.—No change.

August 27.—Pig No 2 appears to be slightly indisposed. Pig No. 3 apparently healthy.

August 28.—Both seem to be healthy; eat well.

August 29.—Pig No. 2 not quite as lively as a healthy pig; does not seem to have very good appetite. Pig No 3 shows no symptons of disease. Temperature of pig No. 2, 105.4° F., and of No. 3, 104¼° F. Both pigs struggled very much while being examined.

August 30.—Pig No. 2 not very lively, and shows a tendency to lie down; does not eat as well as formerly; temperature, 104½° F. At feeding time in the evening it did not arise, nor did it seem to care for its food. Pig No. 3 apparently all right.

August 31.—Pig No. 2 shows plain symptoms of sickness; arches its back, and moves with short undecided steps. Pig No. 3 appears to be less lively.

September 1.—Both pigs, Nos. 2 and 3, show plain symptoms of swine-plague.

September 2.—Pig No. 3 seems to be worse than pig No. 2. In afternoon the eyes of pig No. 3 appeared congested, and the conjunctiva infiltrated with blood. Appetite of both animals rather poor. Both are thirsty.

September 3.—Pigs Nos. 2 and 3 do not eat anything; are evidently very sick; show great indifference to surroundings, and do not like to come out of their corner. Both are very weak, and look as if they suffer from pressure upon the brain.

September 4.—Pigs Nos. 2 and 3 have not touched any food; they huddle together in their corner, lie down, and will not get up unless compelled to do so. Both show increasing muscular weakness and emaciation. At 6.30 o'clock p. m. pig No. 2 was removed to pen No. 1. (See account of pig No. 1.)

September 5.—Pig No. 2 (now in pen No. 1) eats nothing; has plain symptoms of pneumonia. Pig No. 3 (in pen No. 2) is getting very weak; at 7 o'clock p. m. is lying flat, and in a dying condition.

September 6.—Pig No. 2 (in pen No. 1) very sick. Pig No. 3 (in pen No. 2) dead in the morning, with well-marked *rigor mortis*.

Post-mortem examination.—Skin normal; lymphatic glands enlarged; left lobe of lungs partially hepatized; right lobe the same, but hepatization more extensive; no serum in thoracic cavity; about two drachms in pericardium; heart normal; spleen enlarged; partially coalesced with peritoneum of abdominal wall, which shows traces of inflammation; some small ulcerous tumors on surface of spleen, and adhesion between the latter and the colon; mesenteric glands considerably enlarged; morbid growths or ulcerous tumors, and a few worms (*trichocephalus crenatus*), the latter partially embedded in the smaller cæcal mucous membrane in cæcum; blood extravasations, and capillary congestion in mucous membrane of cæcum, colon, ilium, and stomach; liver somewhat enlarged; kidneys normal. The blood, examined under the microscope, contained, besides red blood-corpuscles with ragged, irregular or star-shaped outlines, a few white blood-corpuscles (from one to five in the field), numerous bacillus-germs in various stages of development, and a few developed *bacilli suis*.

Pig No. 2 died at 6 o'clock p. m. (See account of pig No. 1.)

Post-mortem examination.—Skin normal; lungs partially hepatized; hepatization most marked in anterior lobes; small quantity of serum in pericardium; liver enlarged; one nematoid in choledochus; abdominal cavity free from serum; ecchymoses on the external surface of colon and cæcum; capillary hyperæmia and swelling in cæcal mucous membrane; several small ulcerous tumors in cæcum, especially near the ilio-cæcal valve; swelling, capillary congestion, and extravasations of blood in mucous membrane of colon and ilium; kidneys normal; bladder empty; mucous membrane of stomach similar in appearance to that of cæcum, colon, and ilium.

Account of pigs Nos. 5 and 6.—Pigs Nos. 5 and 6, which arrived, as has been stated before, August 22, at 1 o'clock p. m., were put in pen No. 3, and at 1.30 o'clock p. m. the colon, the heart, and a piece of the diseased lungs of pig No. 4 were given to them. They, however, touched neither colon, heart, nor piece of lung.

August 23.—Both pigs, Nos. 5 and 6, in good health, and eat their food greedily, but have not touched the colon, heart, and piece of lung. The colon, having become very putrid, had to be removed; heart and piece of lung were thrown into the feed-trough.

August 24.—Both pigs healthy. Heart and piece of lung have disappeared, but whether they have been consumed by the pigs or by rats I am not able to decide.

August 25.—Both pigs healthy; have good appetite, and eat greedily.

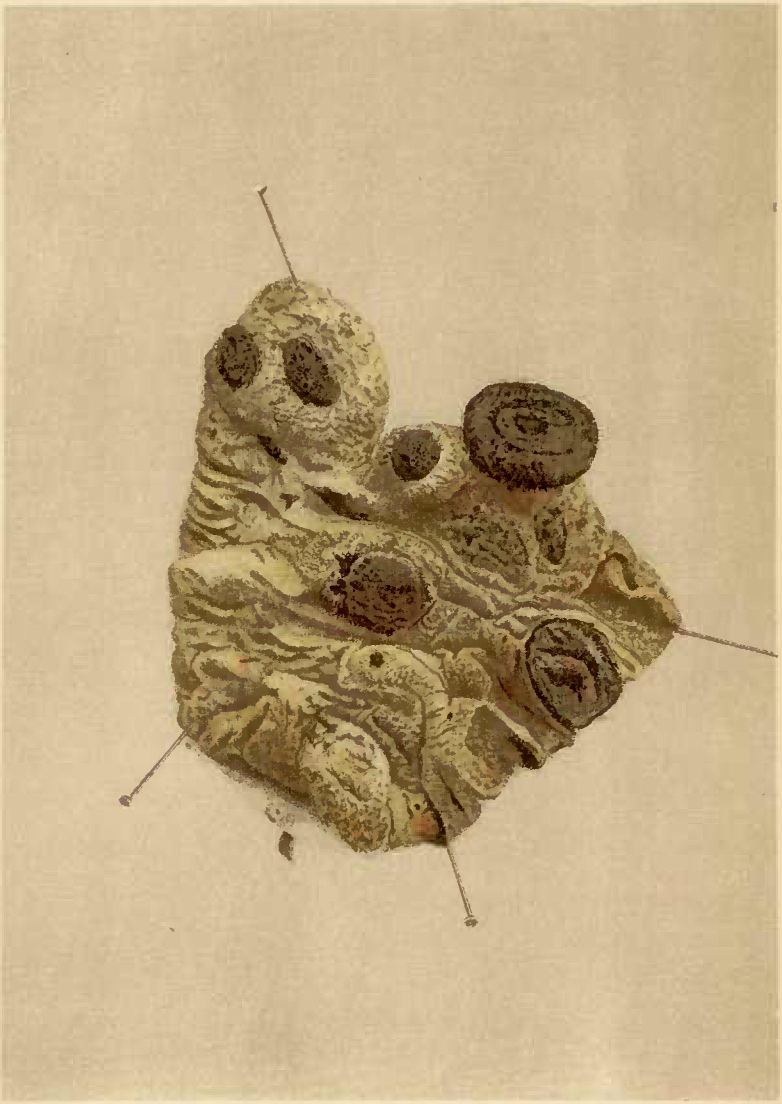
August 26 and 27.—The same.

August 28.—The same. August 28th was a very hot day, but a severe thunder-storm in the afternoon effected a sudden cooling of the atmosphere.

August 29.—Both pigs, Nos. 5 and 6, seem to have a slight catarrah, probably in consequence of the sudden reduction of temperature and change of weather. Both cough some.

August 30.—Both pigs, to all appearances, all right, except that occasionally a slight cough can be heard. Both have first-rate appetites.

August 31.—Both pigs apparently in perfect health; appetite good.



A. Hoen & Co. Lithocaustic, Baltimore.

Ulcerous tumors on mucous membrane of intestines, showing concavity in center.

September 1.—Both pigs all right.
September 2.—The same.
September 3.—The same. Pig No. 5 coughed once or twice, but has excellent appetite.
September 4.—Pig No. 5 coughs again a few times, but is lively, and has very good appetite. No. 6 is all right in every respect.
September 5.—Both pigs all right.
September 6.—Both pigs have good appetite, are very lively, and seem to enjoy good health. At 10.30 o'clock a. m., the entire stomach, cut up into five pieces, the cæcum, and the spleen of pig No. 3 were given to them, and consumed immediately in the presence of Dr. Prentice.
September 7.—Both pigs, Nos. 5 and 6, have very good appetite. No. 5 has a slight cough, and a slight accumulation of mucus in the inner canthi of the eyes. (For further particulars see the accounts given of pigs Nos. 5 and 6 in the chapter on Symptoms and Morbid Changes.)

Having thus ascertained by experiments, just related, that swine-plague is infectious, and can be communicated by inoculation, and also through the digestive canal by a consumption of morbid tissues, I considered it to be of great importance to ascertain, if possible, the nature of the infectious principle; that is, to decide by experiments whether it consists in something corporeal, endowed with life and power of propagation, or in some invisible chemical agency or mysterious fluid, permeating, as has been supposed, the whole animal organism, and contained in, or clinging to, all those substances which possess infectious properties, or constitute the bearers or vehicles of the contagion. As all microscopical examinations of the blood, morbid tissues, and morbid products of forty-two animals, which had been affected with swine-plague and had died of that disease or been killed by bleeding, and repeated microscopical examinations of the excretions (urine and excrements) of diseased animals, have revealed in every case the presence of numerous bacillus-germs (micrococci of Hallier) and developed *bacilli suis*, I deemed it necessary to ascertain first, if possible, the relation which these extremely small microscopic bodies may have to the morbid process and to the infectious principle. For that purpose I commenced another series of experiments, and bought again, on September 24th, three very nice, perfectly healthy pigs, each a little over three months old, of Mr. Burton, residing four miles southeast of Champaign. I designated one of them, a nearly full-bred Berkshire barrow, as pig A; another one, a Poland-China sow, as pig B; and the third one, also a Poland-China sow, as pig C.

Account of pigs A, B, and C.—The same arrived at 10 o'clock a. m. Pig A was put in pen No. 1 with pig No. 1; pig B in pen No. 3 with pig No. 6; and pig C by itself in the thoroughly cleansed and disinfected pen No. 2, formerly occupied by pigs Nos. 2 and 3. Pen No. 2 had been clean and empty since September 6th, and was again disinfected with carbolic acid before pig C was put in.
September 25.—All three pigs, A, B, and C, perfectly healthy.
September 26.—All three pigs perfectly healthy; have good appetite.
September 27.—The same; inoculated pig C with cultivated *bacilli* and bacillus-germs. On September 23d, Professor Burrill charged two drachms of fresh cow-milk with a mere speck, smaller than a pin's head, of a decaying morbid growth, or ulcerous tumor of the cæcum of pig No. 5, and kept the vial well closed, at a temperature of 92° F. On the evening of September 26th the milk was examined under the microscope, and was found to contain numerous *bacilli suis* and bacillus-germs (see drawing III, Figs. 3 and 4), the same as found in the blood-serum, or exudation of diseased lungs, and in the decaying substance of the intestinal morbid growths. The inoculation with this milk was executed in the same way as the inoculations of pigs Nos. 2 and 3; punctures were made on the external surface of the left ear.
September 28.—All three pigs perfectly healthy. The inoculation-punctures on the ear of C slightly swelled.
September 29.—Pigs A, B, and C, all right.
September 30, *and October* 1.—All three pigs perfectly healthy; no symptoms of disease.

October 2.—Pig A perfectly healthy; pig B shows symptoms of sickness, sneezes, has eruption on the ears, diminished appetite, and is not as lively as formerly. As a full account of pig B has already been given in the chapter on symptoms and morbid changes, it will not be necessary to repeat what has been said there, and pig B may be dropped. Pig C apparently all right in the morning. At noon, pig C, too, commences to sneeze; sneezes a good deal, and shivers like a man suffering from ague, but has good appetite.

October 3.—Pig A perfectly healthy. Pig C shows slightly diminished appetite and other plain symptoms of indisposition; is less lively, and has a tendency to lie down; the sneezing continues.

October 4.—Pig A in first-rate health. Pig C a little more lively; has fair appetite, but is not as greedy as formerly.

October 5.—Pig A in fine condition, and all right in every respect. Pig C shivers, and sneezes again a good deal, but does not show any other perceptible symptoms of disease, except some eruptions behind the ears, and on the external surface of the same.

October 6.—Pig A all right in every respect. Pig C about the same as preceding day.

October 7.—Pig A perfectly healthy. Pig C has good appetite, and with the exception of its coat of hair being a little rougher than usual, does not show any plain symptoms of disease.

Made two *post-mortem* examinations of pigs which had died of swine-plague at Mr. Hossack's place, five miles southwest of Champaign. In the evening I examined microscopically the blood-serum or exudations of the diseased lungs of one of Mr. Hossack's pigs, and found normal red blood-corpuscles, numerous bacillus-germs in all stages of development—single, budding, budded or double, and aggregated into clusters—and some developed *bacilli suis.*

October 8. Pig A all right. Pig C shivering again. In the forenoon I filtered some of the blood-serum of the diseased lungs of Mr. Hossack's pig through eight filters—the very finest used in the chemical laboratory of the I. I. University—for the purpose of freeing the serum from the *bacilli* and bacillus-germs; but notwithstanding that I have taken all possible precautions, the filtrate, which was almost limpid, still contained, as examined under the microscope, a great many bacillus-germs. I preserved it in a vial with a tight-fitting ground-glass stop.

October 9.—Pig A healthy. Pig C has fair appetite, but is not greedy. I filtrated the filtrate once more through two filters, and obtained a limpid fluid, which, however, at a microscopic examination, was found to still contain some bacillus-germs. Preserved the filtrate again in a clean vial, with a perfectly-fitting ground-glass stop.

October 10.—Pig A healthy. Pig C eats its food, but is rather slow at it.

October 11. Pig A healthy. Pig C about the same as on preceding day.

October 12.—Pig A healthy; pig C, no perceptible change.

October 13.—Pig A all right in every respect; pig C does not show any plain symptoms of disease in the morning, but is sneezing again in the evening.

October 14.—Pig A in perfect health; pig C sneezes a good deal, but has fair appetite. Took up again the filtrated blood-serum, and finding, on examination under the microscope, that the bacillus-germs had changed to *bacilli* (see drawing XI, figs. 1 and 2), I filtrated the same again through four papers. Dr. Prentice and myself examined the filtrate obtained under the microscope (850 diameters), and neither of us being able to discover any bacillus-germs, I inoculated pig A on the left ear with the filtrate in the same manner in which the other pigs had been inoculated. Made two punctures, but used a needle a trifle larger than the one used before.

October 15.—Pig A all right; no reaction whatever. Pig C sneezing, but fair appetite.

October 16.—Pig A perfectly healthy, and has remained so up to date (November 11th). It has never refused a meal, and has been always very active and lively. It is now a very fine pig and in a first-rate condition. (Made use of the same for another experiment on November 13.) Pig C shows plain symptoms of disease; its appetite is poor, and some emaciation has gradually taken place; at least C has not improved like A, and weighs about half as much as the latter, notwithstanding A is in an open pen, exposed to the inclemencies of the weather, and C in a good, new building, with a shingled roof, in which it is amply protected against the changes of the weather.

October 17.—Pig C rather poor appetite; breathing a little accelerated, and coat of hair somewhat rough and staring.

October 18.—Pig C exhibits plain symptoms of swine-plague; its breathing is accelerated; it sneezes a good deal, and its appetite is poor. Eats some in the evening.

October 19.—Pig C improving; has better appetite.

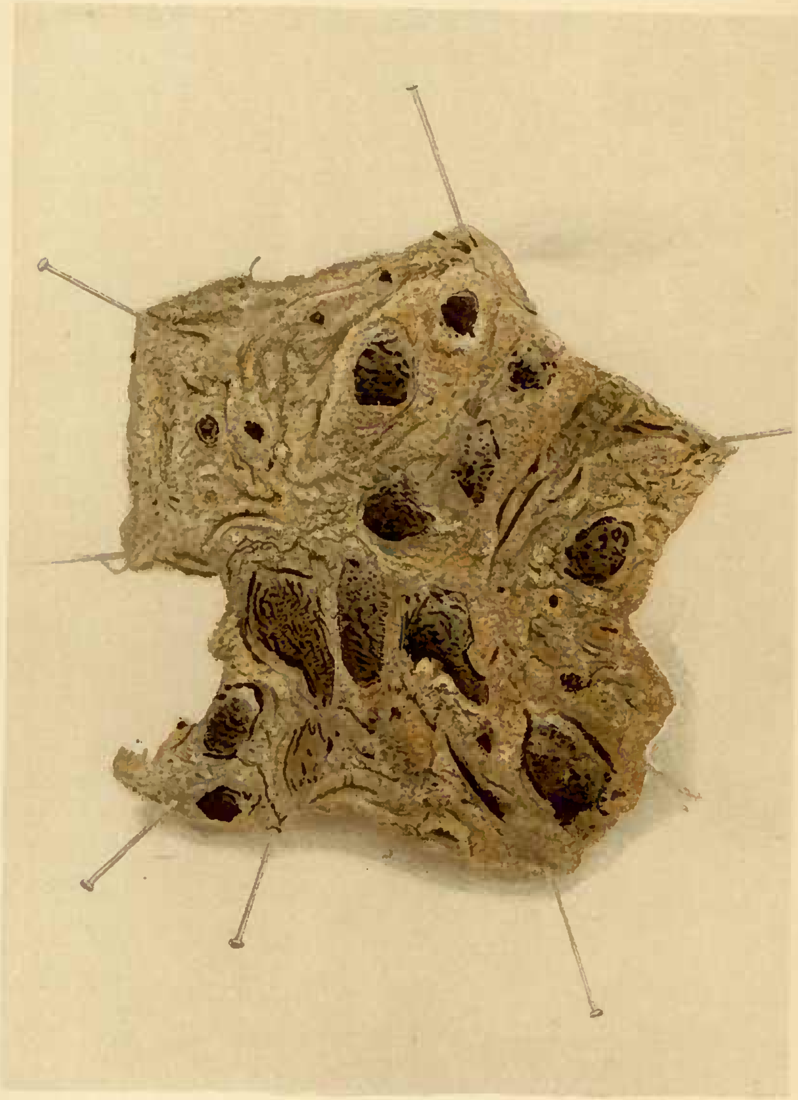
October 20 and 21.—Pig C much improved; eats its food again, but is not greedy.

October 22.—Pig C is lively again, and eats well—at any rate, seems to care more for its food. The sores on the ears are healing and disappearing.

October 23.—Pig C must be considered as fully recovered from its slight attack.

SWINE FEVER.

Report Commissioner of Agriculture for 1878. Plate VI.



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Ulcerous tumors on mucous membrane of intestines, showing different view.

Up to date pig C has presented the appearance of a perfectly healthy pig. Its ears have healed, and are now (November 11th) perfectly smooth. It is lively and greedy for its food, but has grown very little, and weighs to-day about half as much as pig A. It can be seen very plainly that pig C has been sick. When I received A, B, and C, A was slightly the best pig. B came next, and C was the smallest, but the difference was only a trifling one.

The experiments just related show that the *bacilli* and their germs must have a causal connection with the morbid process of swine-plague, because an inoculation with *bacilli* and bacillus-germs, cultivated in such an innocent and harmless fluid as milk, produced the disease, while an inoculation with blood-serum from diseased lungs—a highly infectious fluid, if not deprived of its *bacilli* and bacillus-germs—remained without the slightest effect after it had been freed from its *bacilli* and bacillus-germs. I know very well that the result obtained can hardly be considered as conclusive, and that some more experiments of the same kind are needed to confirm the conclusions arrived at.

5. THE CONTAGION, THE CAUSES, AND THE NATURE OF THE MORBID PROCESS.

That swine-plague is an infectious disease, which can be communicated to heathy animals, has been demonstrated by my experiments. It has further been proven that an exceedingly small quantity of an infectious or contagious substance (blood-serum or exudation, for instance) if inoculated, or directly absorbed by the vascular system, is sufficient to produce the disease. It has also been proven that morbid tissues and morbid products, if consumed by healthy pigs, will cause them to become affected with the plague. Consequently, two ways of infection have been ascertained with certainty. Further, if the results of the *post-mortem* examinations are inquired into more closely, it will be found that the principal morbid changes have occurred in the digestive canal, but especially in the cæcum and colon, in all those cases in which the disease had been communicated by way of the digestive apparatus; and that, on the other hand, the principal seat of the morbid process has been in the organs of respiration and circulation, or in the organs situated in the thorax if the contagion had been inoculated or been introduced into the system through wounds and absorbed by the veins and lymphatics.

Whether an inhalation of the contagious or infectious principle into the respiratory passage or into the lungs is sufficient to produce the disease is doubtful. One pig (pig No. 1), an animal free from any lesions or wounds whatever, has been exposed twice and has not contracted the disease; but while exposed and immediately after its pen was moved once a day, and as the pen was thus kept clean, and as dry earth is a good disinfectant, it must be supposed that the animal was never obliged to consume the contagious principle clinging to the excrements of the diseased animals, neither with its food nor with its water for drinking. Its trough was cleaned three times a day, and always before fresh water was poured in. Pig B, however, was exposed only once, by being kept together with pig No. 6, and contracted the disease in due time. But the conditions were entirely different. Pen No. 3, in which both pigs were kept, contains a wooden floor; pig B was put in soon after pig No. 5 had died, and the pen, otherwise always cleaned once a day, had been left dirty (uncleaned) on purpose. So it happened that the ears of corn, thrown on the floor for food, became soiled, though perhaps only slightly,

with the dung and the urine of dead pig No. 5 and diseased pig No. 6. Further, both pigs (B and No. 6) tramped through the excrements and soiled their feet, and, as pigs will do, went with their dirty feet into the trough which contained the water for drinking. So it is but fair to suppose that pig B contracted the disease, not by inhaling the contagion, but by consuming the same with its food and water for drinking. Hence I have come to the conclusion that swine-plague is probably not communicated through the lungs by an inhalation of the atmosphere surrounding the diseased animals or by simple contact, but that, in order to effect a communication of the disease, the contagion or infectious principle must be introduced directly into a wound within the reach of the veins and lymphatics, or be taken up by the digestive apparatus. This conclusion of mine has been corroborated by several facts, some of which I had an opportunity to observe myself, and some of which have been related to me by reliable persons. To mention a few will suffice: Mr. Henry Yothy, who lives four miles north of Urbana, informed me that his neighbor, Mr. Stickgrath, who lives only one hundred yards south of him, lost every hog but one on his place; that he, Yothy, had nineteen head of swine shut up in a yard, and has not lost a single animal, notwithstanding Stickgrath's diseased animals have been running at large, have tramped all around Yothy's pens, and come every day close to the fence; but that his, Yothy's, hogs have no lesions or wounds whatever, and having remained separated from Stickgrath's hogs by a fence, had no opportunity to consume food or water soiled with the excrements or urine of the latter, and to become infected in that way.

Mr. L. Harris, a few miles north of Champaign, kept his shoats and pigs separate from his older hogs. Among the former, swine plague made its appearance, and proved to be very fatal. They were kept in a yard west of the house, and had access to a pasture to the west and an orchard to the south. The peculiar, offensive smell emanating from that yard was so marked that I perceived it several times very plainly when passing by, at a distance of half a mile or more, so it is to be supposed that considerable contagion must have been floating in the air. The yard in which Mr. Harris kept his old hogs (they were intended to be fattened and were not allowed to run out into a pasture) was not over fifty yards south or southeast of the yard occupied by the diseased and dying shoats and pigs, consequently the wind, usually in the south, carried the effluvia and the foul atmosphere of the former almost constantly into the yard occupied by the old hogs. The latter, notwithstanding, remained exempted. It may yet be stated that the old hogs were fed exclusively with corn, and received nothing but well-water for drinking. On the other hand, I have not been able to learn of any herd remaining exempted after the disease had once made its appearance in the immediate neighborhood, unless the animals constituting the herd were free from any external lesions, were watered from a well, fed with clean food, and shut up during the night and in the morning till the dew had disappeared from the grass, either in a bare yard not containing any old straw-stacks, or in sties or pens. Animals allowed to run out on a pasture or on grass, clover, or stubble fields at all times of the day, and animals that had external sores or wounds, contracted the disease sooner or later in every instance where the plague made its appearance in the neighborhood. Further, the plague, at least during the summer or while south wind was prevailing, seemed to have a special tendency to spread from south to north. If the history of swine-plague is inquired into it will probably be found that that tendency has been prevailing every year. This year, for instance, the disease made its appearance, as I have been informed, for

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Ulcerous tumors on mucous membrane of intestines, showing different view.

the first time, in Wisconsin. These facts, of course, could not fail to be suggestive. So I conceived the idea that the contagious or infectious principle, abundant in the excretions of the diseased animals, might rise in the air in daytime, be carried off a certain distance by winds, and come down again during the night with the dew. That such might be the case appeared to be possible, because the excrements of hogs, if exposed to the influence of sunlight, heat, rain, and wind, are soon ground to powder (partially at least), which is fine enough to be raised into the air and to be carried off by winds. Moreover, as the bacillus-germs, which, I have no doubt, must be looked upon as the infectious principle, are so exceedingly small, it appears to be possible and even probable that they are carried up into the air by the aqueous vapors arising from evaporating urine and moisture contained in the excrements, and from other evaporating fluids (small pools of water), which may have become polluted with the excretions of sick hogs. To ascertain the facts, I collected dew from the herbage of a hog-lot occupied by diseased animals, and also from the grass of an adjoining pasture, and on examining the same under the microscope I found the identical *bacilli* and bacillus-germs invariably found in the blood, other fluids, and morbid tissues of swine affected with the plague. (See drawing VII, fig. 5.) Consequently I have come to the conclusion that the bacillus-germs rise into the air during the day, are carried from one place to another by the wind, and are introduced into the organism of the animal either by eating herbage (grass, clover, &c.), or old straw covered with dew, or by entering wounds and being absorbed by the veins and lymphatics. There is, however, still another way by which the contagious or infectious principle is conveyed from one place to another. It is by means of running water. It has been observed that wherever swine-plague prevailed among hogs that had access to running water (as small creeks, streamlets, &c.), that all the hogs and pigs which had access to the creek or streamlet below contracted the disease, usually within a short time, while all the animals which had access above remained exempted, unless they became infected by other means. I could cite a large number of instances, but as this observation has been made everywhere, probably nobody who is at all acquainted with swine-plague will ask for any further proof.

As to the distance which the infectious principle can be conveyed through the air, I cannot make any accurate statements, but have reasons to believe that swine located a distance of one mile from any diseased herd will be safe. To decide this point, which is of very great importance, requires careful experiments.

The nature of the infectious or contagious principle.—The experiments with pigs A and C, though not conclusive and needing repetition, indicate very strongly, as has already been mentioned, that the *bacilli* and their germs found invariably in the blood, in the morbidly changed tissues, and in the excretions of the diseased swine, must constitute the infectious or contagious principle of swine-plague. I, for my part, am convinced that such is the case. Still I should hesitate to express this opinion if it was supported only by those experiments and not by other facts, such as the peculiarities in the spreading of the disease, the manner in which the infectious principle is acting and is communicated to healthy animals, and the workings of the morbid process. (See next chapter.) At any rate, if the *bacilli* and bacillus-germs constitute the infectious principle, all the strange features of swine-plague find a satisfactory explanation; but if the infectious principle consists in an unknown and mysterious chemical something, the peculiarities of the dis-

ease are, to say the least, enveloped in mystery and cannot be explained. What Professor Beale calls bioplasm could not be discovered under the microscope.

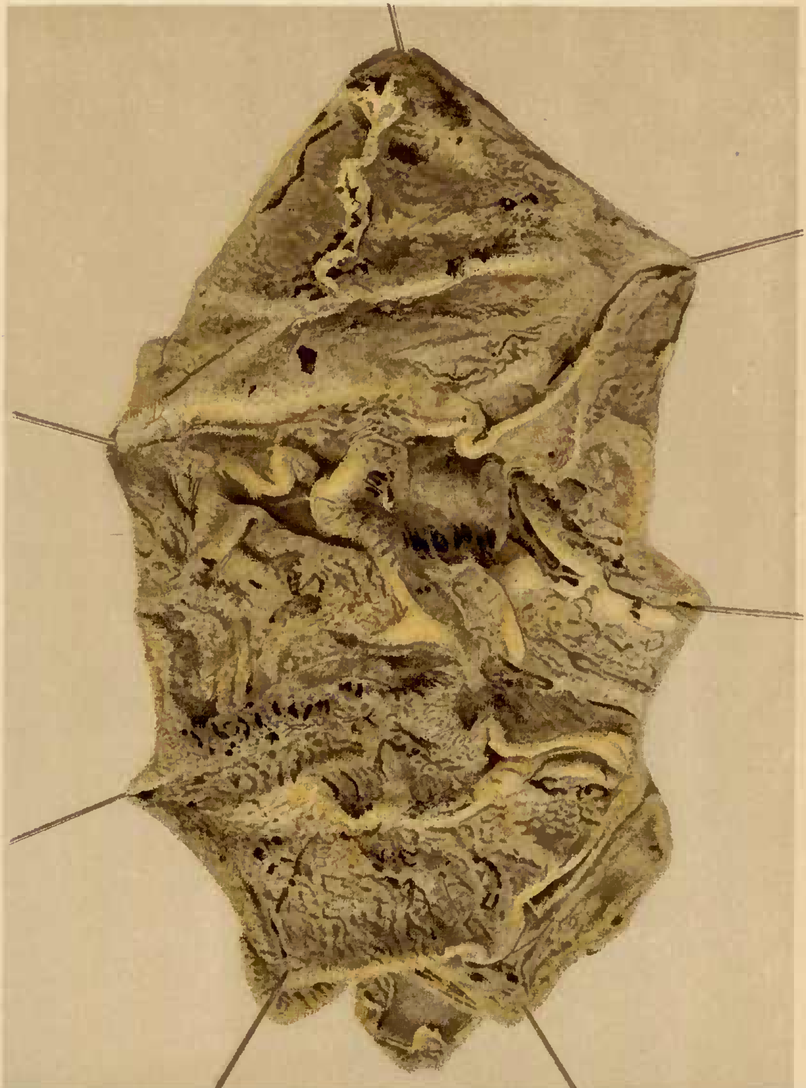
In want of a better name I have called the *bacilli* "*bacilli suis*," because the same, as far as I have been able to learn, are peculiar to and characteristic of swine-plague. The bacillus-germs are small round bodies of—as near as I can figure without the aid of a micrometer—about 0.0007 millimeter diameter, and reflect the light very strongly. The *bacilli suis* are small, almost straight, cylindrical bodies of about 0.003 to 0.005 millimeter in length, and 0.0007 to 0.0008 millimeter in thickness, sometimes moving and sometimes without motion, and in certain stages of development slightly moniliform, but in others apparently not. (See drawings.)

The causes.—Whether the disease is caused exclusively by infection—by the *bacilli* and their germs being conveyed directly or indirectly from diseased animals to healthy ones—or whether those *bacilli suis* and their germs can be produced independently from, and outside of, the organism of swine; whether, in other words, swine-plague is a pure contagion, caused exclusively by means of the infectious or contagious principle, or can develop spontaneously, is a very important question, which can be solved only by protracted experiments, and may not be solved at all until the question as to whether a "*generatio equivoca*" is possible or actually taking place or not has found a definite solution. If the *bacilli suis* and their germs constitute the sole cause of swine-plague, as they undoubtedly do, the disease must be considered as a pure contagion, like many other contagious or infectious diseases, not capable of a protopathic or spontaneous development, as long as the possibility of a "*generatio equivoca*" is denied, but if the latter is admitted, or proved to be taking place, a spontaneous development must be considered not only as possible but also as very probable.

If the conclusions I have arrived at concerning the cause of the disease are correct, and I have scarcely any doubt they are, the question as to the causes has been solved. Still, as a *positive* knowledge of the true cause or causes is of the greatest importance, and as my experiments are not numerous enough to be absolutely conclusive, further investigations and more experiments of the same, or of similar kind, will be very desirable, and, indeed, necessary, in order to obtain *absolute certainty* as to the true nature of the cause or causes.

One thing I am sure of, and that is that an exclusive corn diet, as has been asserted by several agricultural writers, wallowing in dirt and nastiness, starvation, in and in breeding, &c., although by no means calculated to promote health or to invigorate the animal organism, cannot constitute the cause and cannot produce a solitary case of swine-plague, unless the infectious principles (the *bacilli* and their germs) are present. If they are, then, of course, dirt and nastiness, consumption of unclean food and of dirty water, facilitate an infection, and warmth and moisture, pregnant with organic substances, or organic substances in a state of decay, are undoubtedly well calculated to preserve the bacillus-germs and to develop the *bacilli.*

Whether the disease can be communicated to other animals besides swine or not, is a question I am trying at present to decide. Some time ago I had an occasion to throw away some morbid tissues (parts of diseased lungs) of a diseased hog, which I had used for microscopical examination. I threw them—very carelessly, I admit—into an empty lot full of rank weeds, across the road. About a week after several chickens (four or five) died in the neighborhood, of so-called "chicken-cholera."



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Ulcerous tumors on mucous membrane of the stomach

Although there was no proof whatever that these chickens had consumed the morbid tissues, there was a possibility that they had. I bought two healthy chickens, kept them separate, each in a coop, and fed them with the morbidly changed colon of a diseased pig. They consumed the same in my presence, but up to date (November 12th) no results have made their appearance. Further, as no case of an infection of any other animals besides swine has come to my knowledge, it would seem that swine-plague is a disease peculiar to swine like pleuro-pneumonia to cattle.

6. THE MORBID PROCESS.

Concerning the nature of the morbid process, or the manner in which the morbid changes are brought about, the microscope has made some important revelations.

In all those *post-mortem* examinations (fifty-three in number) which I have made since August 3rd, and in all those I had an opportunity of making before that time, I found the lungs more or less affected. The same were partially hepatized, and partially filled yet with fluid exudation or blood-serum. Besides that, where the morbid changes in the lungs were of recent origin, innumerable small red specks, caused by capillary hyperæmia, or, rather, a stagnation of the blood or embolism in the capillaries, could be observed. In several other cases—four or five in number—where the morbid changes in the lungs were not of a recent origin, or older than, say, two weeks, innumerable small, round, and larger confluent tuberculous-looking centers of beginning suppuration or decay (incipient abscesses) presented themselves, especially in the lower and anterior portions of the lungs, and usually more pronounced in the right lobe than in the left one. My friend, Dr. Prentice, who is not only a veterinary surgeon, but also a practicing physician, pronounced the lungs of Mr. Bassett's boar (two years old, and three weeks sick), thus changed, similar or identical in appearance to the consumptive or tuberculous lungs of a human being. Close investigation, however, soon revealed the fact that all the morbid changes found in the lungs of different animals—innumerable small red specks, accumulation of blood-serum or exudation, hepatization, red, brown, and gray, and incipient abscesses—are the products or the consequences of extensive capillary embolism. The other morbid changes, usually found in the thoracic cavity, such as pleuritis, pericarditis, accumulation of straw-colored serum, and the morbid changes found sometimes in the heart, but especially in the auricles, in which, in numerous cases, the capillary vessels have been found to be gorged with blood, tend also to show that embolism constitutes the cause, or at least the main cause, of all those changes. The microscope very fortunately has revealed how this embolism is effected. The capillaries of the lungs, as is well known, are narrower than those in other parts of the body. The blood of the diseased animals, and especially the blood-serum deposited in the affected pulmonal tissue, contain invariably large numbers of bacillus-germs and *bacilli*. These bacillus-germs, as I have observed with the microscope, and as Hallier, who calls them micrococci, nine years ago found, bud and develop to *bacilli*, and show, at a certain period of their development, a great tendency to agglutinate to each other, and to form in that way larger or smaller, irregular-shaped, and apparently somewhat viscous clusters. (See drawing II, fig. 1; drawing IX, fig. 1 *a*.) These clusters, or some of them, are large enough to close or to obstruct the finer capillaries, and to stop in that way the capillary circulation. As a necessary consequence, the serum of the blood transudes through the walls of the capillary vessels,

and is deposited in the tissue of the lungs, in the thoracic cavity, and in the pericardium. In some cases, and at some places, the tender walls of the finer capillaries yield to the pressure and rupture, and then extravasations of blood, such as have been observed in several cases, are the consequence. The capillary redness, and the red and purple spots observed in certain comparatively fine portions of the skin, and in the subcutaneous tissues, I have no doubt, are also a product of the same process, and are caused by capillary embolism. If the animals would only live long enough, gangrene or mortification of parts of the skin would be met with quite often, but as other morbid changes cause death, and thus terminate the morbid process usually before the stagnation of the blood in the skin becomes perfect, gangrene or mortification has been found only once in the skin on the lower surface of the body. Certain morbid changes in the abdominal cavity, such as abdominal dropsy, and the blood extravasations found repeatedly in various organs, such as stomach and intestines, are due to the same cause. The clusters of bacillus-germs also constitute probably the cause of the swelling of the lymphatic glands. Microscopic examinations of the interior of those glands (see drawing IV, fig. 3) revealed invariably, besides some lymph-corpuscles, immense numbers of *bacilli* and bacillus-germs in different stages of development, some budding, some agglutinated to each other, and some in process of agglutination, &c. These clusters of bacillus-germs, it seems, not only close the capillary blood-vessels, but probably also the finer lymphatics ramifying in the glands; a swelling of the latter, therefore, is a natural consequence.

The production of the morbid growths (swine-plague tumors would be a good name), which are found in nearly every case on the mucous membrane of the cæcum and colon, and sometimes, though not so often, on the mucous membrane of other intestines, such as ilium, jejunum, duodenum, stomach, gall-bladder, and uterus, and even on the conjunctiva and the gums, is not so easily explained. It seems that a proliferous process is taking place; new epithelium-cells and connective-tissue corpuscles are formed rapidly, but decay before fully developed. These new morbid and rapidly decaying cells are imbedded in a stroma of a dense connective tissue which, too, is a morbid product, and formed rapidly. In the older and larger morbid growths or tumors in the cæcum and colon this connective tissue is usually very abundant, especially in the frequently pedicle-shaped foot or basis. The proliferous morbid growths which occur in the small intestines are almost destitute of it. If these morbid growths or tumors are examined under the microscope, immense numbers of *bacilli suis*, some of them moving very rapidly and others at rest (sometimes some other bacteria), and comparatively few bacillus-germs will be seen. (See drawing III, fig. 5; drawing VI, fig. 1; drawing V, fig. 2; drawing IV, fig. 2; drawing VII, fig. 2, and drawing X, fig. 2.)

It appears to be probable that the excessive proliferous growth of the epithelium-cells and connective-tissue corpuscles is caused by a constant irritation of the mucous membrane, or of the *membrana intermedia* (basement or limitary membrane, Fleming), produced by the *bacilli*. This is the more probable, as those morbid growths occur especially in such parts of the alimentary canal in which the food is known to tarry the longest, in the cæcum and in the colon. The morbid changes (ulcerations) found occasionally in the skin, where they sometimes cause whole portions to become mortified or decayed and to slough off, occur, it seems, only in parts where a wound or lesion has been existing into which the infectious principle, the *bacilli* or their germs, have been introduced; so, for instance, in the teats of brood-sows wounded by pigs, and in the nose

of hogs and pigs that have been ringed. These morbid changes in the skin, it would seem, are produced in a similar way as the morbid growths in the intestines, with only this difference, that instead of an excrescence loss of substance makes its appearance. The skin is constantly exposed to the atmospheric air, and to a much lower and more changeable temperature than the mucous membrane of the intestines, and in consequence the process of decay may become more rapid and may exceed the probably slower process of production.

7. PERIOD OF INCUBATION.

The period of incubation—perhaps more correctly "stage of colonization," Klebs—or the time passing between an infection and the first outbreak of the disease, I have found to be from five to fifteen days, or on an average of about seven days. Still, I have no doubt that in single cases an outbreak may take place a day or two sooner, and in others, though rarely, a day or two later.

8. MEASURES OF PREVENTION.

As swine-plague is a contagious or infectious disease, which spreads everywhere by means of direct and indirect infection, and as a spontaneous development is problematic, or has not yet been proven, the principal means of prevention must consist in preventing a dissemination of the contagious or infectious principle, and in an immediate, prompt, and thorough destruction of the same wherever it may be found. To prevent successfully a dissemination of the contagion and to secure a prompt destruction of the same, stringent legislation will be found necessary. As it is, the contagion or the infectious principle is, and has been, disseminated through the whole country in a wholesale manner, as I shall show immediately. During the first month of my presence in Champaign I stopped at the Doane House, a hotel belonging to the Illinois Central Railroad Company, and constituting also the railroad depot. Every night car-loads of diseased hogs destined for Chicago passed my window. Only a very short time ago, on one of the last days of October, a farmer, J. T. M., living near Tolono, sold sixty-seven hogs (some, if not all of them, diseased and a few of them already in a dying condition) for two cents a pound, to be shipped to Chicago. I could cite numerous instances, but I think it is not necessary, because these facts are known to every one where swine-plague is prevailing. Besides, in nearly every little town in the neighborhood of which cases of swine-plague are of frequent occurrence, is a rendering establishment to which dead hogs are brought. These establishments pay one cent a pound, and the farmers haul their dead hogs, sometimes ten or fifteen miles, in open wagons, past farms, barns, and hog-lots, and disseminate thereby the germs of the disease through the whole country. The transportation of dead hogs by wagon, I admit, might be stopped by State laws, but the latter prove usually to be ineffective where railroad companies (inter-State and international traffic) are concerned. I include international traffic, because swine-plague is or has been prevailing in Europe. Besides that, there are other contagious diseases which spread exclusively by means of their contagion—I will mention only glanders, foot and mouth disease or aphthæ, and pleuro-pneumonia of cattle—and can be stamped out and be prevented from spreading only by efficient Congressional legislation. Pleuro-pneumonia particularly deserves spe-

cial attention. It has already gained a firm foothold in the East, and would undoubtedly invade the West very soon, or would have done so long ago, if the traffic in cattle were from East to West instead of from West to East. It may, however, at any time be carried to the West by shipments of blooded cattle from the East the same as it was imported from Holland to New York, and having once entered any of the Western States or Territories it will soon find ample means to spread toward the East again and to sweep the whole country. If it comes to that it will prove to be much more disastrous to the live-stock interest of the United States than swine-plague or any other contagious disease.

If any transportation of, or traffic in, diseased and dead swine is effectually prohibited by proper laws, a spreading of the swine-plague on a large scale will be impossible, and its ravages will remain limited to localities where the disease-germs have not been destroyed, and been preserved till the same find sufficient food again. In order to prevent such a local spreading, two remedies may be resorted to. The one is a radical one, and consists in destroying every sick hog or pig immediately, wherever the disease makes its appearance, and in disinfecting the infected premises by such means as are the most effective and the most practicable. If this is done, and if healthy hogs are kept away from such a locality, say for one month after the diseased animals have been destroyed, and the sties, pens, &c., disinfected with chloride of lime or carbolic acid, and the yards plowed, &c., the disease will be stamped out. I know that this is a violent way of dealing with the plague, but in the end it may prove to be by far the cheapest. The other remedy is more of a palliative character, and may be substituted if swine-plague, as is now the case, is prevailing almost everywhere, or in cases in which the radical measures are considered as too severe and too sweeping. It consists in a perfect isolation of every diseased herd, not only during the actual existence of the plague but for some time, say one month, after the occurrence of the last case of sickness, and after the sties and pens have been thoroughly cleaned and disinfected with carbolic acid or other disinfectants of equal efficiency, and the yards, &c., plowed. Old straw-stacks, &c., must be burned, or rapidly converted into manure. It is also very essential that diseased animals are not allowed any access to running water, streamlets, or creeks accessible to other healthy swine. Those healthy hogs and pigs which are within the possible influence of the contagious or infectious principle, perhaps on the same farm or in the immediate neighborhood of a diseased herd, must be protected by special means. For these, I think, it will be best to make movable pens, say eight feet square, of common fence-boards (eleven fence-boards will make a pen); put two animals in each pen; place the latter, if possible, on high and dry ground, but by no means in an old hog-lot, on a manure-heap, or near a slough, and move each pen every noon to a new place, until after all danger has passed. If this is done the animals will not be compelled to eat their food soiled with excrements, and as dry earth is a good disinfectant, an infection, very likely, will not take place. Besides this, the troughs must always be cleaned before water or food is put in, and the water for drinking must be fresh and pure, or be drawn from a good well immediately before it is poured into the troughs. Water from ponds, or that which has been exposed in any way or manner to a contamination with the infectious principle, must not be used. If all this is complied with, and the disease notwithstanding should make its appearance and attack one or another of the animals thus kept, very likely it will remain confined to that one pen.

If the hogs or pigs cannot be treated in that way, it will be advisable

to keep every one shut up in its pen, or in a bare yard, from sundown until the dew next morning has disappeared from the grass, and to allow neither sick hogs nor pigs, nor other animals, nor even persons, who have been near or in contact with animals affected with swine-plague, to come near the animals intended to be protected. That good ventilation and general cleanliness constitute valuable auxiliary measures of prevention may not need any mentioning. The worst thing that possibly can be done, if swine-plague is prevailing in the neighborhood, is to shelter the hogs and pigs under or in an old straw or hay stack, because nothing is more apt to absorb the contagious or infectious principle, and to preserve it longer or more effectively than old straw, hay, or manure-heaps composed mostly of hay or straw. It is even probable that the contagion of swine-plague, like that of some other contagious diseases, if absorbed by, or clinging to, old straw or hay, &c., will remain effective and a source of spreading the disease for months, and maybe for a year.

Therapeutically but little can be done to prevent an outbreak of swine-plague. Where it is sufficient to destroy the infectious principle outside of the animal organism, carbolic acid is effective, and, therefore, a good disinfectant; but where the contagious or infectious principle has already entered the animal organism its value is doubtful. Still, wherever there is cause to suspect that the food or the water for drinking may have become contaminated with the contagion of swine-plague, it will be advisable to give every morning and evening some carbolic acid, say about ten drops for each animal weighing from one hundred and twenty to one hundred and fifty pounds, in the water for drinking; and wherever there is reason to suspect that the infectious principle may be floating in the air, it will be advisable to treat every wound or scratch a hog or pig may happen to have immediately with diluted carbolic acid. During a time, or in a neighborhood in which swine-plague is prevailing, care should be taken neither to ring nor to castrate any hog or pig, because every wound, no matter how small, is apt to become a port of entry for the infectious principle, and the very smallest amount of the latter is sufficient to produce the disease.

Still, all these minor measures and precautions will avail but little unless a dissemination of the infectious principle, or disease-germs, is made impossible. 1. Any transportation of dead, sick, or infected swine, and even of hogs or pigs that have been the least exposed to the contagion, or may possibly constitute the bearers of the same, must be effectively prohibited. 2. Every one who loses a hog or pig by swine-plague must be compelled by law to bury the same immediately, or as soon as it is dead, at least four feet deep, or else to cremate the carcass at once, so that the contagious or infectious principle may be thoroughly destroyed, and not be carried by dogs, wolves, rats, crows, &c., to other places.

Another thing may yet be mentioned, which, if properly executed, will at least aid very materially in preventing the disease; that is, to give all food either in clean troughs, or if corn in the ear is fed, to throw it on a wooden platform which can be swept clean before each feeding.

9. TREATMENT.

If the cause and the nature of the morbid process and the character and the importance of the morbid changes are taken into proper consideration, it cannot be expected that a therapeutic treatment will be of much avail in a fully developed case of swine-plague. "Specific" reme-

dies, such as are advertised in column advertisements in certain newspapers, and warranted to be infallible, or to cure every case, can do no good whatever. They are a downright fraud, and serve only to draw the money out of the pockets of the despairing farmer, who is ready to catch at any straw. No cure has ever been found for glanders, anthrax, and cattle-plague, diseases that have been known for more than two thousand years, and that have been investigated again and again by the most learned veterinarians and the best practitioners of Europe, and yet there is to-day not even a prospect that a treatment will ever be discovered to which those diseases, once fully developed, will yield. Neither is there any prospect or probability that fully developed swine-plague will ever yield to treatment. It is true that the *bacilli suis* and their germs can be killed or destroyed if outside of the animal organism, or within reach on the surface of the animal's body. Almost any known disinfectant—carbolic acid, thymic acid, chloride of lime, creosote, and a great many others—will destroy them. But the *bacilli* and their germs are not on the surface of the body, except in such parts of the skin and accessible mucous membranes (conjunctiva and gums) that may happen to have become affected by the morbid process. They are inside of the organism, and not only in every part and tissue morbidly affected, in every morbid product, and in every lymphatic gland, but they are also in every drop of blood and in every particle of a drop of blood circulating in the whole organism. Who, I would like to ask, will have the audacity to assert that he is able to destroy those *bacilli* and their germs without disturbing the economy of the animal organism to such an extent as to cause the immediate death of the animal? But even if means should be found by which these *bacilli* and their germs can be destroyed without serious injury to the animal, a destruction of the same will not be sufficient to effect a cure. Important morbid changes must be repaired; extensive embolism is existing in some very vital organs; a rapid, proliferous growth of morbid cells has set in; some of the intestines (cæcum and colon) may have become perforated; exudations have been deposited in the lungs, in the thoracic cavity, in the pericardium, and in the abdominal cavity; the heart itself may have been morbidly changed, and every lymphatic gland in the whole organism become diseased. How, I would like to know, will those quacks who advertise their "Sure Cure" and their high-sounding "Specifics" to swindle the farmer out of his hard-earned dollars and cents—how, I ask, will those quacks restore, repair, stop, and reduce all those morbid changes?

Still, I do not wish to say that a rational treatment can do no good; on the contrary, it may in many cases avert the worst and most fatal morbid changes, and may thereby aid nature considerably in effecting a recovery in all those cases in which the disease presents itself in a mild form, and in which very dangerous or irreparable morbid changes have not yet taken place. A good dietetical treatment, however, including a strict observation of sanitary principles, is of much more importance than the use of medicines. In the first place, the sick animals, if possible, should be kept one by one in separate pens. The latter, if movable—movable ones, perhaps six to eight feet square and without a floor, are preferable—ought to be moved once a day, at noon, or after the dew has disappeared from the grass; if the pens are not movable, they must be kept scrupulously clean, because a pig affected with swine-plague has a vitiated appetite, and eats its own excrements and those of others, and, as those excrements contain innumerable *bacilli* and their germs, will add thereby fuel to the flame; in other words, will increase

the extent and the malignancy of the morbid process by introducing into the organism more and more of the infectious principle. The food given ought to be clean, of the very best quality and easy of digestion, and the water for drinking must be clean and fresh, be supplied three times a day in a clean trough, and be drawn each time, if possible, from a deep well. Water from ponds and water that has been standing in open vessels, and that may possibly have become contaminated with the infectious principle, should not be used. If the diseased animal has any wounds or lesions, they must be washed or dressed from one to three times a day with diluted carbolic acid or other equally effective disinfectants.

Concerning a therapeutic treatment, I have made several experiments, the principal ones of which I will relate, not because they are illustrative of success, as they are not, but because some interesting features of the disease will be brought to light. A therapeutic treatment—that is, as far as my experiments are able to show—has not been very successful, but the facts will speak for themselves.

1. EXPERIMENTS AT MY EXPERIMENTAL STATION, THE VETERINARY HOSPITAL OF THE ILLINOIS INDUSTRIAL UNIVERSITY.

October 8.—At 5.30 o'clock, p. m., received from Mr. J. A. Hossack eight diseased swine of various size and age for experimental treatment. They were put in pen No. 3, which had been thoroughly cleaned, and were fed three times a day with corn in the ear, and provided with clean water for drinking. I had engaged and had comfortable room for only three or four, but Mr. Hossack thought best to bring me every sick animal he had at that time on his place. So it happened that five of the pigs were in an almost dying condition when they arrived. I numbered them I, II, III, IV, V, VI, VII, and VIII. The therapeutic treatment consisted in giving three times a day about ten drops of carbolic acid in the water for drinking for each hundred pounds of live weight. In deciding upon that amount, it was taken into consideration that some of the water would remain unconsumed. The troughs were emptied and cleaned each time before fresh water was put in.

October 9.—Pig I, a small animal, dead. *Post-mortem* examination was made by Dr. Prentice, and revealed the usual morbid changes—hepatization, pleuritis, serum in pericardium, and morbid growths in cæcum and colon.

October 10.—Pig II, a large shoat from eight to ten months old, dead. *Post-mortem* examination by Dr. Prentice. Nearly the same results.

October 11.—Pig III, a small animal, dead. It had probably died on the evening of the 10th; at least it was very much decomposed in the morning, and as pig B had died and had to be examined, no *post-mortem* examination was made.

October 12.—Pig IV, dead; had died during the night. No. V, an old sow, and Nos. VI, VII, and VIII yet alive. No. VIII is the only one that has any appetite. Pig VI is very low, and will soon die. *Post-mortem* examination of No. IV Externally: skin on lower surface of the body and between the legs purple. Internally: lymphatic glands enlarged; bronchial tubes filled with mucus; both lobes of the lungs, but the left one more than the right, hepatized—red, brown, and gray hepatization; two ounces of straw-colored serum in pericardium, and plastic exudations on the surface of the heart. In abdominal cavity about one pint of serum; spleen enlarged; kidneys normal; mesenteric glands enlarged; intestines free from any morbid growths, and without any lesions whatever; interior of stomach slightly covered with bile.

October 13.—Old sow No. V and young sow No. VIII (eight months old) have a little appetite. No. VI is very weak, and No. VII is dull; seems to have considerable pressure upon the brain. In the evening No. VI is in a dying condition, and lies motionless in a corner. Sows Nos. V. and VIII have some appetite; No. VII breathes with a throbbing motion of the flanks; seems to have headache, is very dull, and holds its nose persistently to the floor.

October 14.—Sow VIII considerably improved; sow V some appetite; VII very low; and VI dead. For *post-mortem* examination of No. VI, see account given in the chapter on Morbid Changes.

October 15.—Old sow No. V and sow No. VIII coughing a good deal; VIII has a good appetite; V has not. No. VII, a sow pig about eight months old, dead in the

pen. *Post-mortem* examination of No. VII at 8.30 o'clock a. m. Externally: Skin on nose, neck, and lower surface of body purple in spots and patches; carcass not very much emaciated. Internally: some adhesion between posterior part of right lobe of lungs and diaphragm; costal pleura and pericardium affected; surface of the lungs exhibits numerous small red specks; both lobes are partially hepatized, and contain considerable exudation yet in a fluid condition. (See photographs, Plates I and II.) External coat of posterior vena cava morbidly changed, inflamed, and coalesced with pulmonal pleura. In abdominal cavity: numerous light-colored nodules or tubercles on the surface of the spleen, some of the size of a millet seed, and others as large as a small pea; mesenteric glands very much enlarged; numerous small ulcerous tumors or morbid growths on mucous membrane of cæcum and colon; the whole interior surface of jejunum, for several feet in length one uninterrupted layer of a morbid growth and subsequent decay of epithelium cells, easily removed with the back of the scalpel, and leaving behind, if thus removed, an uneven villous surface.

October 16.—Old sow No. V and sow No. VIII fair appetite; both cough a great deal. Old sow V discharged yesterday and to-day large quantities of a glassy mucus exuding from the nose. Discovered two ulcerating sores, one in the left middle teat and one in the right forward teat. Her pigs had been weaned a short time before she contracted the disease.

October 17.—Sows V and VIII improving, that is, are less indifferent to surroundings and have better appetite, but still cough a great deal.

October 18.—Sows V and VIII improving; but especially VIII, which has good appetite. In afternoon sow V had some diarrhea, probably caused by feeding on new corn—old corn had been fed before.

October 19.—Old sow V has diarrhea; feces green and semi-fluid. Sow VIII seems to be improving, at least eats a good deal. Sow V is perfectly blind.

October 20.—Sows V and VIII still coughing considerably, but are otherwise improving.

October 21.—Sows V and VIII improving; VIII is already in a little better condition.

October 22.—Sows V and VIII improving.

October 23.— Sow V is still very slow in her movements, but her appetite is much better. Sow VIII still shows difficulty of breathing, but may otherwise be considered as recovered. The diarrhea of sow V has disappeared.

October 24.—Sows V and VIII improving; have good appetite, and are not near so thirsty as formerly; both cough some. Recovery may be considered certain.

October 25.—Sow V very much improved; ulcer in forward teat is healing rapidly (the ulcers have been treated with diluted carbolic acid). Sow VIII shows no morbid symptoms, except some coughing and some difficulty of breathing. She has very good appetite and is very lively.

October 26.—Sow V eats tolerably well, but is still weak. Sow VIII eats and drinks well, and might be looked upon as perfectly healthy if it were not for the yet existing difficulty of breathing. The excrements have gradually lost their peculiar offensive smell.

October 27.—Sow V fair, and sow VIII very good appetite. The latter is getting lively.

October 28.—No perceptible change.

October 29.—Sow V more active, but still partially blind. Sow VIII is gaining in flesh.

October 30.—Both sows have good appetite and are visibly improving.

October 31.—Both improving steadily.

November 1.—Sows V and VIII keep on improving. The ulcers of sow V have healed, and her sight has been partially restored. The carbolic-acid treatment has been continued to this day (November 1), but is now discontinued.

November 6.—Both sows have been returned to their owners. Sow VIII is like a perfectly healthy pig, but coughs some and also shows a slight difficulty of breathing. Sow V has almost entirely recovered her eyesight; is not in as good condition as sow VIII, and coughs some, but breathes perfectly easy.

October 26.—Received of Mr. D. Burwash, at 6 o'clock a. m., a Berkshire pig, about five months old, for experimental purposes; it had been sick two or three days. It proved to be very severely affected, but was in a good condition as to flesh. Treatment: about eight or nine drops of carbolic acid in the water for drinking every morning, and about two drams of bisulphite of soda and one dram of carbonate of soda every evening. The pig was designated as No. IX, and put in pen No. 2.

October 27.—Pig No. IX worse; has plain symptoms of pneumonia; died in the afternoon. *Post-mortem* examination three hours after death; four ounces of serum in chest, and also a like quantity in pericardium; trachea filled with mucus; both lobes of lungs congested and gorged with exudation; capillary vessels of the auricles of the heart gorged with blood; spleen enlarged, and large numbers of tubercle-like excrescences on its lower surface; cæcum and colon full of hardened feces; a few ulcerous tumors in cæcum, and two large decaying morbid growths in colon; mesenteric glands enlarged; other organs healthy.

Numerous other experiments have been made, and quite a variety of medicines have been tested at different places and in different herds. Some of those experiments have been carried out under my personal superintendence, and some by the owners of the diseased animals in accordance with my instructions. But as the results obtained with any one of them are far from satisfactory, it will be sufficient to mention only a few. The principal medicines tried were carbolic acid, bisulphite of soda, thymol, salicylic acid, white hellebore or *veratrum album*, as an emetic, alcohol, and sulphate of iron, and it has been found that neither of them possesses any special curative value. In a few cases in which most of the lesions were external, applications of very much diluted thymol or thymic acid produced apparently good results; the animals recovered, but might have recovered at any rate. Diluted carbolic acid has been used for the same purpose and with the same results. An emetic of white hellebore or *veratrum album* was given to some shoats (about eight or nine months old, and property of Dr. Hall, at Savoy), in the first stage of the disease, and seemed to have arrested the morbid process immediately, at least the shoats recovered. In other more developed cases it did no good whatever. Bisulphite of soda, salicylic acid, and carbolic acid were used quite extensively, but no good results plainly due to the influence of those drugs have been observed in any case in which the disease had fully developed, neither by myself nor by others. Sulphate of iron has proved to be decidedly injurious. Mr. Bassett used it quite persistently for forty-five nice shoats. Forty-three of them died, one recovered from a slight attack—it had external lesions, which were treated with carbolic acid—and one remained exempted. To bleed sick hogs, in some places a customary practice among farmers against all ailments of swine, has had invariably the very worst consequences, and accelerated a fatal termination. A great many farmers in the neighborhood of Champaign have used several kinds of "specifics" and "sure cure" nostrums, but none of them are inclined to talk about the results obtained, and so it must be supposed that the latter have remained invisible. One case, which should have been related in the chapter on "Prevention," deserves to be mentioned. Mr. Crews had forty-odd hogs, of which he had lost ten or twelve, and was losing at the rate of two to four a day. I advised him to separate those apparently yet healthy, or but slightly affected, from the very sick ones; to put the former in a separate yard, not accessible to the others; to feed them clean food; to water them three times a day from a well, and to give to each animal, two or three times a day, about ten drops of carbolic acid in their drinking water. He did so, and saved every one he separated (fourteen in number), while all others, with the exception of two animals which died later, died within a short time.

Respectfully submitted.

H. J. DETMERS, *V. S.*

CHICAGO, ILL., *November* 15, 1878.

SUPPLEMENTAL REPORT.

SIR: Since the 15th of November, the day on which I forwarded to you my full report, I have devoted my time principally to a solution of some of those questions which had not been fully answered, and have succeeded in ascertaining some additional facts of practical importance. In addition to this the correctness of my conclusions as to the nature of the infectious principle, and the manner in which swine-plague is communicated, has been confirmed by further observations. The vitality of the infectious principle has been tested by experiment; several herds of diseased swine and places where the disease had been prevailing, and where healthy pigs had been introduced a few weeks after the occurrence of the last case of swine-plague, have been visited, and a few more *post-mortem* examinations have been made. In the following, which may be considered as a supplement to my report of the 15th of November, I have the honor of submitting to you, very respectfully, the results of my investigation.

1. THE BACILLI SUIS.

These are found invariably, either in one form or another, in all fluids—such as blood, urine, mucus, fluid exudations, &c.—in all morbidly affected tissues, and in the excrements of the diseased animals, and constitute, beyond a doubt, the infectious principle, or produce the morbid process if transmitted, directly or indirectly, from a diseased animal to a healthy one. These *bacilli* undergo several changes, and require a certain length of time for further propagation; consequently, if introduced into an animal organism, some time—a period of incubation, or a stage of colonization—must pass before morbid symptoms can make their appearance. Three stages of development (a germ or micrococcus stage, a bacillus or rod-bacterium stage, and a germ-producing stage) can be discerned.

The micrococci, globular bacteria, or bacillus-germs, as I prefer to call them, are found in immense numbers in the fluids, but especially in the blood and in the exudations of the diseased animals. If the temperature is not too low, and if sufficient oxygen is present, they soon develop or grow lengthwise, by a kind of budding process—a globular bacterium, or bacillus-germ, constantly observed under the microscope, budded, and grew to double its length in exactly two hours in a temperature of 70° F. (see drawing)—and change gradually to rod-bacteria, or *bacilli*. Some of the latter, finally, after a day or two, if circumstances are favorable, commence to grow again in length, until they appear, magnified 850 diameters, to be from one to six inches long. At the same time, however, they become very brittle, and break into two or more pieces. Where a break or separation is to take place, at first a knee or angle is formed, and then a complete break or separation is effected by a swinging motion of both ends, which move to and fro, and alternately open and close, or stretch and bend the knee or angle. After the division has become perfect, which takes only a minute or two, both ends, thus separated, move apart in different directions. These long bacteria, it seems, are pregnant with new germs; their external envelop disappears or is dissolved, and then the very numerous bacillus-germs become free. In this way a propagation is effected.

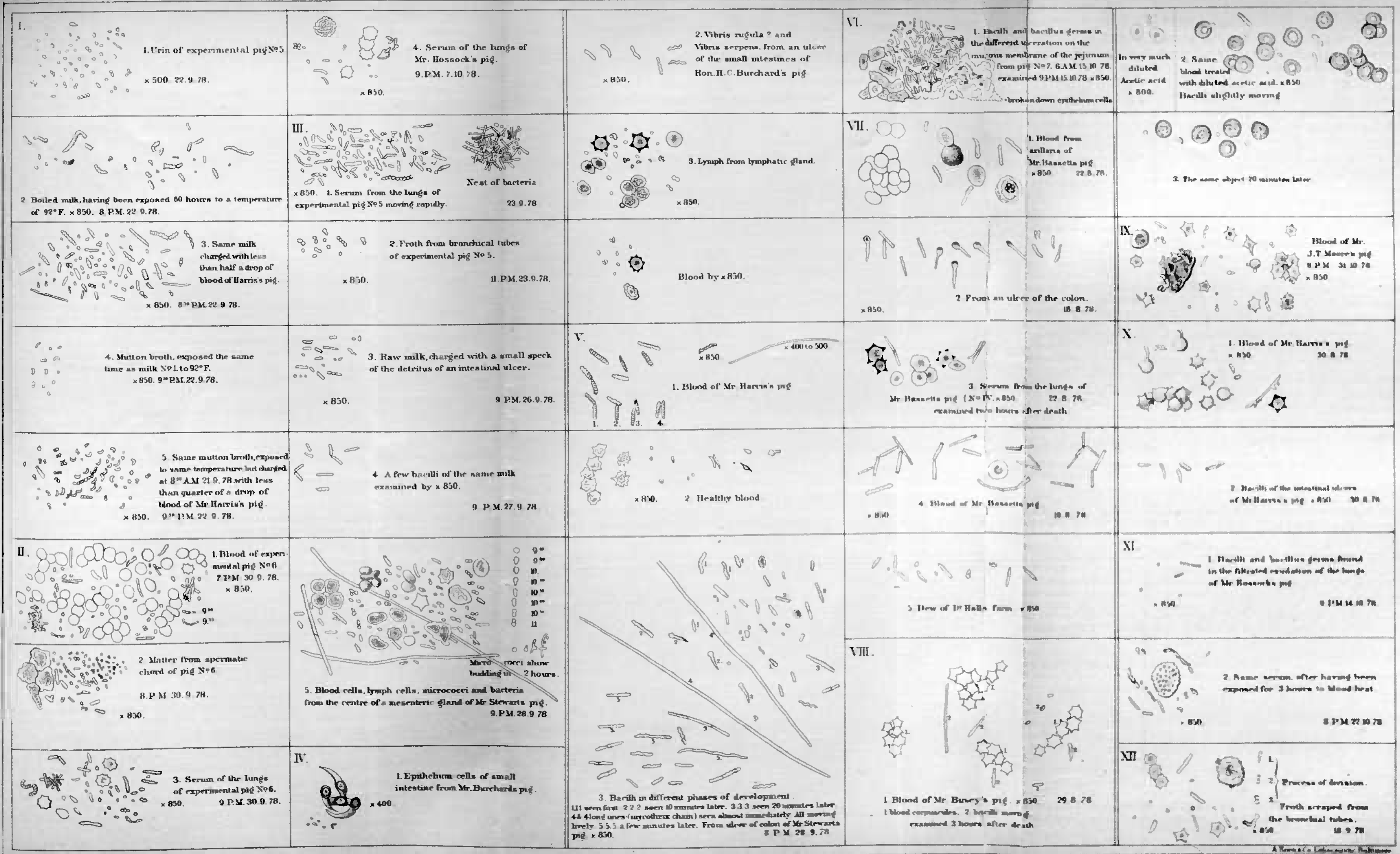
Some of the *bacilli* or rod-bacteria move very rapidly, while others are apparently motionless. The causes, of this motion I have not been able to ascertain with certainty, but have observed repeatedly that no motion takes place if the temperature of the fluid or substance which contains the bacteria is a low one, and that under the microscope the motion increases and becomes more lively if the rays of light, thrown upon the slide by the mirror, are sufficiently concentrated to increase the temperature of the object. So it seems that a certain degree of warmth is required; at any rate I never saw any *bacilli* moving in a fluid or substance immediately after it had been standing in a cold room.

There is, however, also another change taking place, caused probably by certain conditions which I have not been able to ascertain. It is as follows: The globular bacteria or bacillus germs commence to bud or grow in length, but on a sudden their development, it seems, ceases, and partially-developed *bacilli* and simple and budding germs congregate to colonies, agglutinate to each other, and form larger or smaller irregularly-shaped and (apparently) viscous clusters. Such clusters are found very often in the blood and in other fluids, and invariably in the exudations in the lungs; and in the lymphatic gland in pulmonal exudation, and in blood serum, this formation can be observed under the microscope if the object remains unchanged for some time, say for an hour or two. In the ulcerous tumors on the intestinal mucous membrane the clusters are comparatively few, but the fully-developed *bacilli*, many of which move very lively, are always exceedingly numerous. The tumors or morbid growths in the intestines seem to afford the most favorable conditions for the growth and development of the *bacilli* and their germs. That this must be the case is also suggested by the presence of such immense numbers of *bacilli* and bacillus-germs in the excrements,

SWINE-PLAGUE.

Microscopical Investigations by Dr H. J. Detmers.

Bacilli and Bacillus Germs.



that the latter, beyond a doubt, constitute the principal disseminator of the infective principle. Whether the colonies or viscous clusters of bacillus-germs and partially developed *bacilli* are instrumental in bringing about the extensive embolism in the lungs and in other tissues, by merely closing the capillary vessels in a mechanical way, or whether the presence, growth, development, and propagation of the *bacilli* and their germs produce peculiar chemical changes in the composition of the blood, which disqualify the latter to pass with facility through the capillaries, or which cause a clotting or retention of the same in the capillary system, is a question which I am not prepared to decide. According to my own observations, it appears that the colonies or viscous clusters of bacillus-germs and partially developed *bacilli* get stuck in the capillaries so as to obstruct the passage, and constitute in that way the principal, if not the sole, cause of the embolism. Dr. Orth is of a different opinion. He says: "The principal effect of the 'Schizomycetes' (*bacteria, bacilli, &c.*) is an indirect one, viz., by producing a poison (virus)." (*Archiv. fuer wissenschaftliche und praktische Thierheilkunde*, 1877, *page* 1.) It is possible that the circulation of the blood in the capillary system is interfered with by both mechanical obstruction and chemical changes. Still, it seems to me that the observations of Dr. Orth and others apply more to the fully developed *bacilli* in the blood and in the lymph. The vitality of the bacillus-germs, and especially of the *bacilli*, is not a very great one, except where the germs are contained in a substance or a fluid not easily subject to decomposition; for instance, in water which contains a slight admixture of organic substances. If such a fluid is kept in a vial with a glass stop, the germs remain for a long time (over six weeks) in nearly the same condition, or develop very slowly, according to amount of oxygen and degree of temperature. In an open vessel the development is a more rapid one. If oxygen is excluded, or the amount available exhausted, no further change seems to be taking place. In the water of streamlets, brooks, ditches, ponds, &c., the bacillus-germs are not destroyed very soon. How long they retain their vitality I have not been able to ascertain. In fluids and substances subject to putrefaction, the *bacilli* and their germs lose their vitality and are destroyed in a comparatively short time; at least they disappear as soon as those fluids (blood, for instance) and substances undergo decomposition. In the blood they disappear as soon as the blood-corpuscles commence to decompose. That such is the case has been ascertained not only by microscopical observation, but also by clinical experience. The *bacilli* and their germs are also destroyed if brought in contact with, or if acted upon by, alcohol, carbolic acid, thymol, iodine, &c.

2. CLINICAL OBSERVATIONS.

he experimental pigs, Nos. 1 and A, put in pen No. 2, on November 13th (together with experimental pig C), in which pen pig No. IX had died of swine-plague on the 28th of October, remained perfectly healthy, notwithstanding pen No. 2, which was thoroughly infected, had received only an ordinary cleaning, but had not been disinfected. Consequently, it must be supposed that the infectious principle (the *bacilli* and their germs) contained in particles of excrement and in the urine clinging to the floor and lodged in the cracks between the boards must have been destroyed, because I observed repeatedly that the pigs, probably in search of saline substances, licked those parts of the floor which had become saturated with urine.

Mr. Bassett, who had lost nearly his whole herd of swine—of one lot containing originally forty-five animals only two survived—bought, about eighteen days after the occurrence of the last death, two young, healthy pigs, and allowed them to run at large in his orchard, a pasture, and one of his swine-yards, the same premises on which the lot of forty-five animals just mentioned had been kept. The few surviving hogs of his old herd are kept in another yard farther north. Seeing that those two pigs remained healthy, he thought he might risk it and buy some more, and about two weeks later he bought sixty-nine (not ninety-five, as I believe I have stated in my report) healthy Berkshire shoats, from five to six months old, at the auction of the Hon. James Scott, president of the Illinois State Board of Agriculture, and turned them out on the same premises (hog-lot, orchard, and pasture). After these sixty-nine shoats had been there two days they discovered the burial places of the forty-three dead shoats, hogs, and pigs, which, by the way, had been buried only from two to three feet deep. These they commenced to exhume immediately, and soon consumed all the decomposed carcasses. Mr. Bassett would have prevented this had he discovered them in time. Every shoat has remained healthy up to date (November 29th), and as the period of incubation (from five to fifteen days, or on an average seven days) expired some time ago, it must be supposed that the infectious principle, the *bacilli* and their germs, had been thoroughly destroyed by putrefaction. It must be mentioned that there are no straw-stacks, &c., on the swine-range, and that the shoats have no access to any streamlet, ditch, or pool of water.

Mr. Locke's herd of swine has been kept perfectly isolated in a pasture near the city limits of Champaign, and has remained exempt from swine-plague till lately. The hog-pasture is close to the Illinois Central Railroad track. Whether the infec-

tious principle has been introduced into Mr. Locke's pasture by the car-loads of diseased swine which pass by every evening, and which sometimes remain standing on the tracks, at a distance of not much over forty rods from the hog-pasture, for half an hour or longer; whether the vicinity of the rendering establishment has been instrumental in bringing about an infection; or whether the infectious principle has been communicated by other means, I have not been able to ascertain.

The herds of Mr. Clelland (or McClelland), nine or ten miles northwest of Champaign, and of Mr. Allen, six or seven miles northeast of Urbana, have remained exempt for a long time, probably because neither of them has any close neighbors, but finally the disease, spreading from farm to farm, has reached their herds.

Mr. Clay West, three and a half miles northwest from Champaign, living also somewhat isolated, expected that his swine (forty-seven head) would remain exempted. Most of them (forty-two or forty-three) obtained their water for drinking from a running streamlet which, three-fourths of a mile above, passes through the hog-pasture of another farm. On the latter swine-plague made its appearance, and three weeks later Mr. West's swine commenced to die. So it must be supposed that the infection had been brought about by the water in the streamlet. Mr. West, as soon as he found that his hogs commenced to die, sold twenty-seven head to be shipped to Chicago.

3. MORBID CHANGES AFTER DEATH.

Since November 15th I have made some more *post-mortem* examinaiions, mostly for the purpose of obtaining material for microscopical investigation; but have found nothing not found before, or of any special importance, except in one case, of which, therefore, a full account may not be superfluous. It was a pig of Mr. Clellan's (or McClelland's), who had lost four head out of seventeen within a few days, or after brief sickness. The pig in question, which was a little over four months old, had been sick only two or three days. The *post-mortem* examination was made on November 22d, about sixteen hours after the animal had died.

Externally.—Considerable capillary redness of a purple hue in the skin on the lower surface of the body, between the legs, and behind the ears. *Internally.*—Lower and anterior parts of both lobes of the lungs hepatized (red hepatization); the rest of both lobes gorged with blood-serum or fluid exudation; pericardium coated with plastic exudation; auricles of the heart congested, the capillary vessels tinged with dark-colored blood; lymphatic glands, but especially those of the mesenterium, very much swelled; liver, sclerotic; serous membrane of some of the intestines (cæcum and colon) coated with exudation; ecchymoses and capillary redness in pyloric portion of the stomach; and a few worms (*Trichocephalus crenatus*) in cæcum, but no morbid growths or ulcerous tumors whatever in any part of the digestive canal. This case is worth mentioning, because no morbid growths or ulcerous tumors were found in the cæcum and colon, or in other parts of the intestinal canal; it consequently shows once more that embolism and subsequent exudation in the lungs and in other tissues are more constant and more characteristic of the morbid process of swine-plague than the peculiar morbid growths or ulcerous tumors in the cæcum and colon.

Whether those ulcerous tumors on the intestinal mucous membrane occur only in cases in which the infectious principle has been introduced partly or wholly through the digestive canal, and are absent in those cases in which the *bacilli* and their germs have entered exclusively through wounds or lesions, or whether, finally, this presence or absence depends upon other influences and conditions, is a question which I am not fully prepared to answer. It has decidedly the appearance that the seat and the character of the morbid changes depend, to a certain extent at least, upon the means and parts by and through which the *bacilli* and their germs have entered the animal organism.

My opinion, expressed in my report of the 15th ultimo, that an infection is brought about either through the digestive canal or through wounds or lesions, and probably not through the respiratory mucous membrane and through the skin, if no wounds or lesions are existing, has been corroborated by an observation made at Mr. West's place. I was there on November 20th. The disease had made its appearance on November 10th. Mr. West had lost five animals, had sold twenty-seven more or less diseased, and still had fourteen or fifteen, including four or five older hogs kept in a separate pen, about 12 by 16, which had a wooden floor, and was separated from the hog-lot or hog-pasture only by a board fence. These older animals receive and have received their water for drinking from a well, while all those kept in the hog-lot or hog-pasture, originally forty-two in number, had access to the streamlet before mentioned. None of the older animals, although breathing the same atmosphere as the rest, showed any symptoms of disease, and are still healthy (November 29th), as far as I have been able to learn.

In conclusion, I may say that swine-plague does not seem to be communicable to any other domesticated animals, and must be considered as a disease *sui generis* peculiar to swine.

I intended to make further experiments, by inoculating healthy animals with blood-serum or pulmonal exudations, freed from *bacilli* and bacillus-germs by repeated filtrations and with cultivated *bacilli*, but the time left me (sixteen days) was not sufficient to obtain reliable results. Besides, it appeared to be desirable to use the pigs I had on hand for the purpose of testing the vitality of the infectious principle in such a way as would give the test a direct practical value.

I am, very respectfully, your obedient servant,

H. J. DETMERS, *V. S.*

CHICAGO, ILL., *December* 1, 1878.

REPORT OF DR. JAMES LAW.

Hon. WM. G. LE DUC,
Commissioner of Agriculture:

SIR: I have the honor to submit the following report of experiments and observations on the prevailing fever in hogs.

As you are already aware, my attention has been directed mainly to the pathology of the disease, the nature and vitality of the virus, and its behavior when treated by different disinfectants. Distant as Ithaca was from all infected districts, and seeing it was impossible here to experiment on large herds of diseased and exposed swine, it seemed preferable to leave to others all essays of treatment and prevention of the illness by the use of disinfectants and other sanitary measures. This isolated and noninfected locality offered special advantages for conducting that class of observations which I aimed at, as there was no danger of accidental infection from other sources than the experimental pens. At the same time the number of animals subjected to experiment was limited by the necessity for the most perfect isolation of the healthy and diseased, for the employment of separate attendants for each, and for the disinfection of instruments used for scientific observations, and of the persons and clothes of those who conducted these.

The experimental pens were constructed in a high open field, with nothing to impede the free circulation of air; they were large and roomy, with abundant ventilation from back and front, with perfectly close walls, floors, and roofs, and in cases where two or more existed in the same building the intervening walls were constructed of a double thickness of matched boards with building pasteboard between, so that no communication could possibly take place excepting through the open air of the field. When it seemed needful disinfectants were placed at the ventilating orifices. On the pigs showing the first signs of illness, infected pigs were promptly turned over to the care of attendants delegated for these alone, and the food utensils, &c., for the healthy and diseased were kept most carefully apart. When passing from one to the other for scientific observations, the healthy were first attended, and afterward the diseased, as far as possible in the order of severity. Then disinfection was resorted to, and no visit was paid to the healthy pigs until after the lapse of six or eight hours, with free exposure in the interval. In the pens the most scrupulous cleanliness was maintained and deodorizing agents used so as to keep them perfectly sweet.

I may be allowed to add that I have received most valuable assistance from two of my students, Messrs. A. M. Farrington and A. G. Boyer, in conducting the daily observations, as well as in making *post mortem* examinations, and in the examination of diseased products.

INCUBATION OF THE DISEASE.

Our experiments have shown this to vary greatly, though in the great majority of cases it terminated in from three to seven days after inoculation. As shown in the table appended, one sickened on the first day, three on the third, two on the fourth, one on the fifth, two on the sixth, four on the seventh, and one each on the eighth and thirteenth days respectively. A comparison of these results with those obtained elsewhere seems to show that we have reached the two extremes. Dr. Sutton, observing the result of contact alone in autumn, sets the period at from thirteen to fourteen days; my own observations in Scotland, in summer, indicated seven to fourteen days; Professor Axe, in London, in summer, concluded on five to eight days; Dr. Budd, in summer, four to five days; and Professor Osler, in autumn, four to six days.

SYMPTOMS.

The cases observed were of all degrees of severity, from a slight access of fever, with some loss of appetite, irregularity of the bowels, and alternations of heat and cold on the surface, to violent attacks, terminating fatally after eleven days' illness.

Early symptoms.—In an average case, one of the earliest signs of illness was an elevated temperature of the body, amounting to one or two degrees above the former indications furnished by the same animal. This qualification appears requisite, as the temperatures of healthy pigs were found to vary widely under different conditions of life. After active exercise or excitement 104° F. is not unfrequent, while in a close pen where they are quiet and still, 100° to 102° F. is quite as common. On more than one occasion, when a pig got accidentally fixed in a narrow space where he had barely room to stand, the temperature was reduced to 99° and even 98° F. The body heat was raised by a hearty meal and lowered by abstinence. Generally a sudden rise of temperature and saturation of the atmosphere with moisture led to an elevation of the body heat, in other cases a reduction of the temperature of the air led to the same phenomenon. (See table of Meteorological Observations and Temperatures.) In connection with the rise of temperature there was generally a diffuse redness of the skin, with increased warmth, alternating with cold, especially in the ears, nose, tail, and limbs. The pulse usually rose perceptibly, sometimes reaching 120 per minute, while the breathing was little if at all affected. The snout was often drawn back, giving a wrinkled or pinched appearance to the face; the movements were less active, sometimes decidedly stiff and slow; there was perceptible falling off in appetite, and the bowels were usually costive.

Disease at its height.—The temperature rose in most cases to 105° F., and exceptionally only to 107° or 108° F. (Dr. Osler records 110° F.), to be followed after a variable length of time (three to twenty days) by a a descent to the natural standard, or even lower. The pulse also rose to 120–130, and the flushes of heat on the skin were much more frequent and extreme. At the same time certain changes appeared in the skin, varying greatly in degree in different cases, but which may be described as follows:

First. A pink or scarlet rash in spots averaging about one-tenth inch in diameter, but often becoming confluent so as to form an extended blush. Many such spots disappeared momentarily under pressure, showing that the minute blood-vessels were not yet completely blocked, but only dilated. Many, however, could not be even temporarily obliterated

by pressure, showing already existing embolism if not even rupture and the escape of the blood-elements into the tissue.

Second. In some, though by no means in all, there appeared black spots on which pressure had no effect. The cuticle of such spots dried up and shrunk, and if the pig survived long enough was finally detached.

Third. In nearly all there were slight pointed elevations, mostly around the roots of the bristles, which over the whole body had become more erect, rough, and harsh.

Fourth. Scattered more or less abundantly over the surface were black concretions, hardening in most cases into a scab, but in others, and particularly on the inner side of the thighs, accumulating as a soft, greasy inunction. Where this was not diffused as a uniform black incrustation, it showed as small black particles mostly at the roots of the bristles, and was evidently a product of the diseased sebaceous glands.

Fifth. The skin showed at many points, and above all on the pendent margins of the ears, on the hocks and knees, on the rump and abdomen, an unbroken blue or violet tint, which could not be effaced by pressure. In bad cases this was associated with considerable swelling of the ears, and in one with rupture of the integument and loss of blood.

Finally. A great accumulation of scurf took place along the back, and with the tough, rigid state of the skin contributed much to the unthrifty look of the subject.

The arching of the back, the drawing up of the flank, the advance of the hind toward the fore feet, and the stiff movements of the hind limbs sufficiently attested abdominal suffering, while the contractions of the rectum resisting the introduction of the thermometer testified in most cases to the irritability of the bowels, if not to the thickening and corrugation of their mucous membrane. The gait was stiff and uncertain, and the patient inclined to lie in its litter, by preference stretched on its belly. The bowels at this stage were mostly irritable. In the milder cases they were mostly costive, or if the dung was of natural consistency it smelt strongly. In the worst cases, and in several of the milder ones, they became relaxed with a semi-solid fetid discharge, or a yellowish white or slaty yellow watery flow, alternating with more confined or costive conditions. Vomiting was noticed once or twice, but was altogether exceptional. One patient ground its teeth, but one only. Several had a cough, occurring in paroxysms, but the majority had none, and this is the more remarkable that several of those that appeared to show this immunity harbored numerous lung-worms. In most cases the inguinal glands could be felt to be enlarged.

Stage of sinking.—When patients were approaching death, the temperature, after reaching its highest point, suddenly descended to below the natural, the pulse increased to 130 or even 160 per minute, extreme weakness supervened so that the animal could barely rise or drag itself around; in some cases the nervous powers were so dulled that the pig lay in a stupor, hardly disturbed when pricked to obtain a drop of blood for examination, and in others there seemed to be active delirium, with sudden starting and screaming. Nervous disorder was further shown by general tremors and muscular jerking of the limbs or body. If formerly purging, the anus became relaxed, and the liquid feces escaping involuntarily smeared the thighs and bed. In two this state of things lasted for two days before death supervened. At this stage moving bacteria were repeatedly detected in the blood.

Subsidence of fever.—In cases which seemed to promise recovery, including a majority of the whole, the temperature declined gradually

toward the natural standard, the bowels became more regular, the appetite improved, the skin cleared up, and all the bad symptoms steadily diminished. As it was not our object to preserve them they were either sacrificed or again inoculated, so that the too frequently tardy and imperfect or uncertain convalescence was not verified in our pens.

POST-MORTEM LESIONS.

In considering the morbid anatomy of the disease, the lesions of the skin referred to above under the head of symptoms need not be again recorded.

The characteristic lesions were found especially in the digestive organs, the lymphatic glands, and the lungs, though the serous membranes and other tissues were by no means always exempt.

Digestive organs.—In four cases the tongue was the seat of spots of a deep-blue color, ineffaceable by pressure, and in three cases it bore distinct ulcers, similar to those to be described later as existing in the large intestine. Similar ulcers appeared on the soft palate, in two cases, and on the tonsils in one. In four cases the pharynx bore indelible blue spots of extravasation, but no distinct ulceration. In one instance a white concretion in four minute lobes, like pins' heads, was found on the mucous membrane on the back of one arytenoid cartilage, consisting of rounded nucleated cells and granular matter. In one case only did the gullet show patches of congestion. The stomach always contained a fair amount of food, usually smelt intensely acid, the exhalation fuming with ammonia, and presented on the mucous membrane of its great curvature a mottled, dark-brown discoloration, as is often seen in pigs that have been starved for some time prior to slaughtering. In four cases this membrane bore patches of thickening from $\frac{1}{4}$ to 1 inch in diameter, of a deep-red color, from blood extravasation into and beneath the mucosa. In two cases it bore a dirty yellowish-white pellicle of diphtheritic-looking false membrane, the microscopic characters of which will be noted hereafter. In one case slight erosion of the membrane had ensued, but without the formation of any slough.

The small intestines constantly presented spots of congestion, and sometimes extended tracks of the same, with softening of the mucous membrane and excessive production of mucus. The spots were easily overlooked unless when the entire length of the gut was slit open and carefully examined, but when closely examined they presented not only the branching redness resulting from coagulation of blood in the capillary blood-vessels, but also microscopic extravasations of the blood out of thin natural currents. Another point which served to characterize these limited congestions was a greater or less hæmorrhagic reddening of the mesenteric glands immediately adjacent to the congested spots. In three cases only were distinct erosions found on the small intestines, and in one, ulceration with the dirty-white central slough so common in the large intestines. The edge of the ileo-cæcal valve was twice the seat of a sloughing ulcer, and in four subjects the glandular follicles of Peyer's patch were enlarged at this point, a condition which is, however, not uncommon in pigs killed in health.

In the large intestines the lesions were at once more constant and more advanced. The cæcum was the seat of dark-red patches from congestion and extravasation in six cases, the colon in six, and the rectum in five. Ulcers appeared on the cæcum in eight cases, on the colon in seven, and on the rectum in three. In two cases the whole length of the large intestine was the seat of great thickening of the mucous membrane,

which was of a deep, dark-red color, and thrown into prominent transverse folds, that considerably diminished its internal caliber. The large intestine was more entirely free from slight congestion of the mucous membrane, and in two cases only were no ulcers found on this part.

The variety of these ulcers deserves a passing notice. In a certain number of cases the mucous membrane, though comparatively free from congestion, showed a number of small conical swellings, with yellowish depressed centers, and about the diameter of one-half a line. To the naked eye these appear like enlarged solitary glands, but have been shown by Dr. Klein, of London, to be enlarged and diseased mucous crypts (follicles of Lieberkühn.) Next, erosions of larger size were not uncommon. In these, the surface layer of the mucous membrane was destroyed, leaving a depressed, red, congested base, and swollen, slightly congested, and reddened edges. Then there are the older ulcers in which, with a more or less reddened base and margin, there is a central dirty-white product, arranged in concentric layers, and usually projecting above the line of the adjacent mucous membrane, and even overlapping it. This appears like a slough, and though sometimes stained with blood contains no pervious vessels. In one instance this slough, in place of occurring in rounded isolated forms, extended transversely to the direction of the intestine, occupying the limits of its morbid transverse folds for half the circumference of the canal, or even more. These bands were abundant in the cæcum and colon, and at intervals two adjacent ones would merge into each other at their widest parts. Finally, in one case, a great part of the surface of the cæcum and colon was covered by a yellowish-white dipthheritic-looking pellicle, in patches of several inches in length, and projecting above the surface of the mucous membrane at its free border.

In one case only was there a blood-colored liquid effusion into the peritoneum. In another, a transparent exudation between the folds of the mesentery contained a microscopic embryo worm; but the most careful search could detect no others at this point, nor in the coats of the intestines. In one case, whitish concretions were found on the mesentery, projecting from the surface and composed of granular cells like those of the concretion on the larynx.

Liver.—Slight ecchymosis on the surface of the liver was common, but extensive congestion, and above all softening, were virtually absent. When congestion existed the acini were most deeply colored in the center, showing the implication of the hepatic veins and intralobular flexus rather than the portal system. In two cases this organ contained slight caseous deposits, in one an *acephalocyst*, and several times *hydatids*.

The *pancreas* appeared to be uniformly healthy.

The *spleen* appeared unduly black and gorged with blood on two occasions only, and in the worst of these the blood was alive with actively-moving bacteria.

The *lymphatic glands* of the mesentery and of the abdomen generally may be said to have been uniformly altered. Those in the vicinity of congested or ulcerated patches of intestines were usually of a dark blood-red, confined to the surface of the gland, or in the worst cases extending through its entire substance. In cases where the disease had passed the crisis, and the subject was advancing towards recovery, there was often simply a grayish discoloration of the surface of the gland, where such hæmorrhagic discoloration would have been found in the earlier stages. In all cases the glands appeared to be materially enlarged.

These remarks would equally apply to the lymphatic glands in the chest, throat, or other parts where congestion and ecchymosis existed.

Respiratory organs.—Congestions and ecchymosis were common on the larynx, windpipe, and pleuræ. Though the lungs never entirely escaped, in one case only was an entire lung hepatized. Exudation and consolidation of the lung-tissue were in a few instances confined to the anterior lobes, but as a rule a few of the posterior lobulettes only were affected. In some cases exudation was confined to the interlobular spaces, which accordingly appeared as broad lines circumscribing the lighter-colored lobes, with which they contrasted strongly in color because of their dark blood-stained exudate. Even when the lobules were also the seat of exudation, they were mostly lighter than the interlobular spaces, in this differing from the ordinary inflammation of the lungs, in which the latter appear as yellow lines. The bronchia of the affected lobules were invariably filled with a frothy mucus, while in eight subjects they contained numerous lung-worms (*Strongylus elongatus*). It is worthy of notice that in nearly all cases in which lung-worms were found, the lobules into which the exudate had taken place were invariably connected with the infested bronchia. In one case the windpipe presented along its whole length a yellowish-white false membrane similar to that described as existing on the large intestine. In another instance a blocked bronchium presented a small circular slough not unlike the commencing slough of the intestinal mucous membrane. In no case did I meet with the caseous blocking of the bronchia recorded by Klein.

In one case only was there extensive liquid effusion into the pleuræ. This was of a dark blood color, and, besides, the blood-globules contained myriads of actively-moving bacteria. False membranes of recent formation also connected the pulmonic to the phrenic pleuræ in this case. The right lung was hepatized throughout. In the same subject the pericardium was the seat of a similar exudate, and fibrinous coagula connected the cardiac to the mediastinal layer. In three cases the lining membrane of the heart was the seat of spots of ecchymosis, by preference on the papillary muscles. The right heart usually contained a clot of blood which showed a buffy coat in three cases only. In two cases there was a clear translucent exudation around the auricule ventricular furrow, which, under the microscope, showed fat cells and granules, and a network of capillary vessels in which the blood-globules moved freely, and showed no tendency to adhere.

Brain.—In one case there were four hæmorrhagic spots on the duramater, averaging about one line in breadth.

MICROSCOPIC OBSERVATIONS.

Skin.—Microscopic sections through the affected portions of skin showed the various grades of congestion; congestion with blocking of the capillaries, and excess of lymphoid and large granular cells and granules staining deeply with coloring agents; and congestion, with extravasation and the formation of necrotic spots. (See Plate IX, Fig. 1.) With the earlier congestion there is more or less dropsy of the skin and consequent separation of its intimate textures, while in the later or more severe conditions a fribinous exudation takes place, and this may even exude from the surface and concrete there in dark scabs. In no instance did I meet with the formation of pus in the skin, and notwithstanding the numerous minute extravasations into the true skin and cuticle, in one case only was there sufficient destruction of a superficial vessel to lead to a temporary hæmorrhage. One feature which I have not seen mentioned by other observers is the implication of the bristle follicles. It has been already stated that the pink papular eruption is mostly ob-

SWINE FEVER.

Fig.1.
Microscopic section through skin and slough.

Fig.2.
Microscopic section of skin in purple spot.

A.Hoen & Co.Lithocaustic.Baltimore

served around the roots of the bristles, and it may be added that the bristles always stand erect and harsh. Moreover, in addition to the general unthriftiness and scurfiness of the skin, it tends early to become coated with greasy exudation, resulting usually in the black concretion already mentioned and soluble in ether. This is manifestly a product of the hair follicles and their sebaceous glands, and accordingly a section through one of these shows the deep congestion of the capillary plexus. (See Plate IX, Fig. 2.)

Intestine.—Sections through those portions of the mucous membrane which are merely congested and reddened, but without ulceration, shows stagnation and blocking of the capillary vessels in the mucosa and submucosa, with thickening and softening of the textures, and especially of the epithelial layer. This last contains a great excess of granules and aggregations of granules into cell forms (giant cells of Klein), while the epithelial cells themselves are reduced in size and contain enlarged nuclei. As formerly pointed out by Klein, the degeneration is often greatest around the openings of the crypts of Lieberkühn, and in their interior, while their cavities are not unfrequently filled with extravasated blood. Besides the above are found lymphoid and wandering blood cells, crystals of hæmatine and closely aggregated masses of granules staining deep purple blue in hæmatoxylon and insoluble in caustic potass —the micrococci of Klein. These last are especially abundant on the surface, but extend into the deeper fibrous layers as well. In severe cases the epithelial layer may be raised from the mucosa by a considerable dark-red clot, though the escape of blood in large amount is more frequent under the mucous membrane, so as to separate it from the muscular coat.

The ulcers with a central slough present at their base the same characters as the congested mucous membrane, as regards cellular and granular proliforation, blocking of vessels, exudation, and microscopic extravasation. The slough may be shown to be made up mainly of small nucleated cells and granules, but it retains under the microscope its close laminated appearance, caused by the gradual extension in depth and breadth by the death of successive layers of the mucous membrane. It contains numerous groups of the granular bacteria already referred to, and extending down to its deepest strata.

Lymphatic glands.—As regards the lymphatic glands, I need only repeat the statement of Klein, that the blocking of vessels and extravasation of blood is most commonly into the outer or cortical portion alone; in the more severe forms in which the medullary part is also implicated, the blood effusion is often confined to the lymph-channels and the connective tissue-partitions, while the glandular cylinders escape. It is in cases of longer standing that the cell changes are the most marked. Then there may be found in the lymph-channels the giant cells already mentioned, and the groups of granular-looking micrococci, similar to those found in the intestinal ulcers, as well as lymph-cells of an abnormally dark granular aspect.

Organs of respiration.—The characteristic lesion of the lungs is lobular pneumonia, the exudation taking place most abundantly into the connective tissue between the lobules, and there assuming a dark color by reason of the abundant escape of blood-globules. On making a microscopic section across the smaller air tubes and air sacks, we find in the connective tissues generally, and in the walls of the alveoli and around the bronchia an exudation containing an excess of small round lymphoid cells and granules, and in the air cells themselves accumulations

of similar rounded cells (Klein's giant cells), granular matter, and clumps of granular bacteria.

In one instance the wind-pipe from larynx to lung had its superior wall covered by a yellowish-white diptheritic-looking layer similar to that which I found on another occasion throughout nearly the whole large intestine. A section of this under the microscope showed mainly small rounded granular cells, Klein's large granular uniocular cells, and clusters of the granular masses of bacteria, staining deeply with hæmatoxylon. The liver sometimes showed congestion and blocking of its intralobular capillaries and an escape of small rounded granular cells (lymph) into the interlobular spaces, the latter affording a marked contrast to the redness in the center of the acini.

Kidneys.—These were, with one exception, pale in their cortical portion, and a cloudy swelling existed in the walls of the tubules. Spots of blood-staining were common on the papillæ, and at those points the capillaries were blocked by coagula to a greater or less extent.

Blood.—In most cases no alteration of the blood was detected. In one pig, however, on the second day before death, the blood swarmed with bacteria, showing very active movements. In the subjoined drawings (Plate XIII, Fig. 3) may be seen the various forms presented by one bacterium in a few minutes only. The blood of another pig, which had been inoculated from this one showed the same living germs in equal quantity. They were further found in the blood of a rabbit and sheep inoculated from the first-mentioned pig. In an abscess of a puppy which had also been inoculated the germs were abundant. The blood was not examined. In the blood of healthy pigs no such organisms were found. It may be added that the greatest precautions were taken to avoid the introduction of extraneous germs. The caustic potass employed was first fused, then placed with reboiled distilled water in a stoppered bottle that had been heated to a red heat. The glass slides and cover glasses were cleaned and burned, the skin of the animal cleaned and incised with a knife that had just been heated in the flame of a lamp, the caustic solution and the distilled water for the immersion lens were reboiled on each occasion before using, and finally the glass rods employed to lift the latter were superheated before being dipped in them. On different occasions when the animal was being killed I even received the blood from the flowing vessels beneath the skin into a capillary tube which had just been purified by burning in the flame of a lamp. With these precautions it might have been possible for one or two bacteria to get in from the atmosphere, but not for the swarms I found as soon as the blood was placed under the microscope.

PARASITIC WORMS.

In view of the fact that the swine-fever has been repeatedly ascribed to the ravages of worms, it may be well to notice specially those that were found in the pigs subjected to experiment.

Strongylus elongatus (Dry.), *Paradoxus* (Mehlis), *Lung-worm.*—The first eight pigs were purchased of a butcher, and had been fed on offal from his slaughter-house. The lungs of all these contained these worms in numbers varying from ten to forty full-grown specimens, and one pig died, apparently from this cause, on the seventh day. The worms were mostly found in the terminal part of the main bronchium in the posterior lobe of one or both lungs. Others of the air-tubes were, however, occasionally infested. The infested tubes were filled with a glairy mucus, rendering them totally impervious to air, and containing the

SWINE FEVER.

Report Commissioner of Agriculture for 1878. Plate XIII.

Forms assumed in rapid succession by bacterium; also head and tail of lung worm.

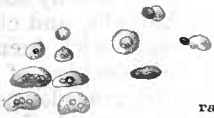


Fig. 3. Forms assumed in rapid succession by a bacterium from the blood of a sick pig. x1000.

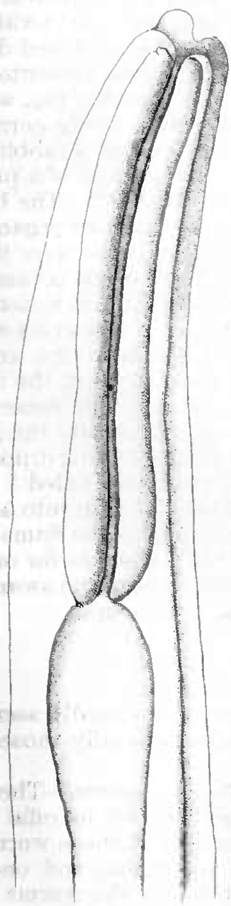


Fig. 4. Head of Lung Worm. Strongylus Elongatus.

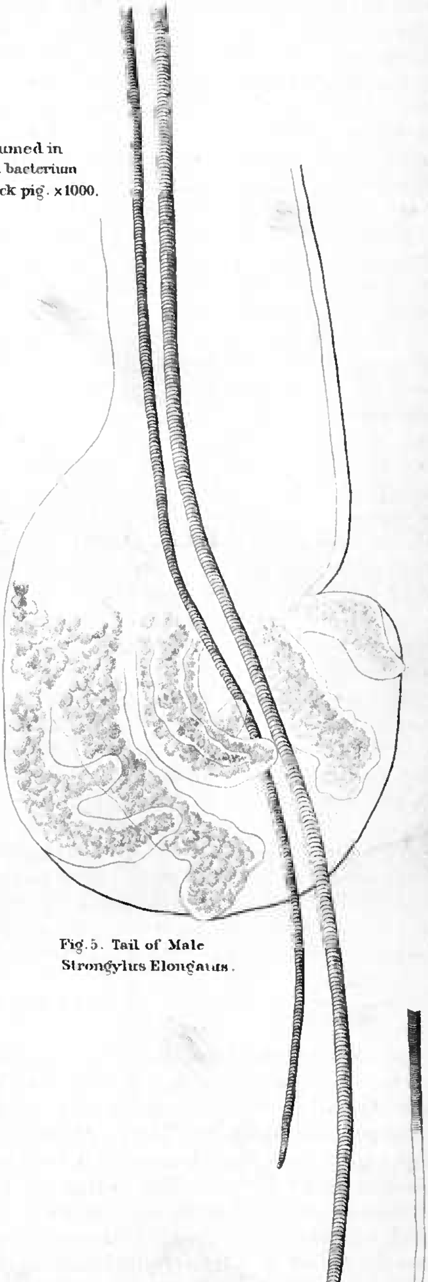


Fig. 5. Tail of Male Strongylus Elongatus.

A. Hoen & Co. Lithocaustic. Baltimore.

white thread-like worms and myriads of microscopic eggs. In every case the lobules to which such obstructed air-tubes led were red, congested, and solid, or, as in one or two instances, dropsical, and of a slightly translucent, grayish color. Sections of the diseased portion showed the air-cells partially filled with an exudate in which small rounded cell-forms predominated. The walls of the air-cells were the seat of congested and blocked capillaries and granular cells, while in most cases there were superadded the more specific characters of the fever—the presence of the worms and their irritation having evidently determined the lesions of the specific fever to the infested lobules.

The worms may be thus shortly described: Head slightly conical; mouth terminal, small, circular, with three papillæ; body like a stout thread, white or brownish, skin nonstriated; œsophagus short, 0.63 millimeters, enlarged posteriorly, club-shaped (Plate XIII, Fig. 4); intestine slightly sinuous, and longer than the body; anus opening on a papilla a little in front of the tail. *Male*, 8 to 9 lines in length; tail curved, furnished with a bilobed membranous pouch supported by five rays, two of them double, and two long delicate spiculæ with transverse markings (see Plate XIII, Fig. 5). *Female*, 1 to 1½ inches long; tail turned to one side, narrowing suddenly to be prolonged as a short, curved, conical point; genital orifice in the anterior half of the body, yet close to the middle; oviducts very much convoluted. The *ova* are slightly ovoid $\frac{1}{500}$ inch in diameter, and appear as if they filled the entire body of the adult female (see Plate XIV, Figs. 6, 7, and 8).

Habits.—Like other *strongyli*, these worms attain sexual maturity in the body of their host, and they lay their eggs in the bronchia, to be carried out in all probability and hatched in pools of water and moist earth. It is worthy of note that though I found in the bronchia and air cells eggs in all stages of segmentation, and those containing fully-formed embryos, I did not find a single free embryo worm. The presumption is that, like other closely related worms, they are only hatched out of the body, and that the microscopic embryos live for a variable length of time in water or moist earth, and on vegetables, to be taken in with these in feeding and drinking.

That these worms are injurious there can be no doubt. Pigs infested by them thrive badly, and many die, as did the poorest of my first experimental lot. Like all parasites, they multiply rapidly wherever their propagation is favored by the presence of large herds of swine, and especially if these are kept on the same range and water season after season. In such circumstances they will produce a veritable plague, proving especially destructive to the younger pigs. There is little doubt that many outbreaks of alleged hog-cholera, in which the lungs alone are affected, are but instances of the ravages of these lung-worms, but that they are the cause of the specific fever which we are investigating is negatived by the complete absence of these worms in all of my second experimental lot.

Tricocephalus Dispai (*Creplin*) *Whip-Worm of Swine.*—This I found in large numbers in the cæcum and colon of the experimental pigs, and especially of the first lot—those that had been fed on raw offal. This worm is characterized by a long, delicate, filiform anterior part of the body, and a short, thick, posterior portion. The narrow portion is 0.02 millimeters broad and exceedingly retractile; the posterior portion may be almost 1 millimeter thick. The tegument is very finely striated across, and has a longitudinal papillated band. The œsophagus is very wide and slightly tortuous. The *male* is about 1½ inches long but the thick portion does not much exceed ½ inch, and is curved in a spiral. The

spiculum measures about 1 line, and is furnished with a funnel-shaped membranous sheath. The *female* is $1\frac{1}{2}$ to 2 inches in length, the thick portion varying from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch. The posterior portion is brownish, filled with eggs, and ends in a blunt point. The *ova* are 0.052 millimeters in diameter, with a transparent button-like prolongation at each pole.

Like as with other round worms, the ova are laid in the body of the host, but passing out are hatched in water, &c., the young spending their early life in pools, streams, &c., and gain access to the body in food and drink. The worm we are at present considering is especially injurious because of its infesting the human being as well as the pig. Living in the large intestine, it bores its head and much of its anterior filiform body deeply ($\frac{1}{4}$ inch) into the mucous membrane and sucks the blood. When present in large numbers it determines active inflammation of the large intestines, with costiveness or diarrhea, and a rapidly-advancing bloodlessness. Inasmuch as the seat of its ravages, the cæcum and colon, is specially obnoxious to the lesions of the true hog-fever, epizootics caused by the undue prevalence of these worms are very liable to be confounded with the latter disease. The worms are so small that they are easily overlooked among the solid contents of the viscera, unless special care is exercised in the search.

Sclerostomum dentatum (Diesing).—This is another small worm of the cæcum and colon of pigs, found on one occasion only in my experimental animals. It varies from $\frac{1}{3}$ to $\frac{1}{2}$ inch in length and is about $\frac{1}{5}$ line in thickness, hence perhaps more easily overlooked than is the whip-worm, but no less injurious. The body is of a dark gray, brown, or black, according to its contents; the tegument covered with very fine transverse striæ, head broad, mouth terminal, round, and furnished with six very sharp horny teeth, with which to penetrate the mucous membrane. The gullet is broad and club-shaped, and furnished with two salivary glands, opening by delicate canals into the mouth. Intestine wide and sinuous. *Male*, $\frac{1}{3}$ inch long, $\frac{1}{60}$ inch in thickness; tail furnished with a bell-shaped membranous expansion, supported by three rays, but open on one side. Testicle single and extended in a sinuous manner from near the gullet to the tail. Two delicate spiculæ. *Female*, 4 to 5 lines in length, tail slowly narrowed and terminated abruptly with a sharp projecting point. Ovaries very tortuous, extend from near the gullet to the tail, where they end in a globular enlargement, beneath which, and close to the point of the tail, is the vulva. The ovoid eggs are laid in the intestines, and carried out with the dung, in which they will hatch, and give exit to the embryo worms on the third day. Like all this family of round-mouthed worms, this fixes itself to the mucous membrane by its mouth, penetrates the tissues with its sharp teeth, and lives upon the blood. If present in large numbers it may establish such a drain that the host becomes pale and bloodless, rapidly loses condition, and perishes from anæmia. It will also, like the whip-worm, irritate the bowels and bring on fatal inflammation, with constipation or diarrhea. In both cases alike the lesions are in the cæcum and colon, the common seat of ulceration, &c., in the specific fever; hence the epizootic is liable to be set down as hog-cholera. It should be added that some members of the family of *Sclerostomata*, and notably the *Sclerostomum equinum* (*Sclerostomum* of the horse), pass a portion of their early life encysted in the mucous membrane and even in other internal organs, and there is some reason to suppose that the *Sclerostomum* of the pig has similar habits, which add materially to the irritation caused by its presence in large numbers. The pigs in Virginia reputed as dying from hog-cholera, caused

SWINE FEVER.

Report Commissioner of Agriculture for 1878. Plate XIV.

Ova, hooks, and head and tail of lung worms.

Fig. 8. Head of Female Strongylus Elongatus.

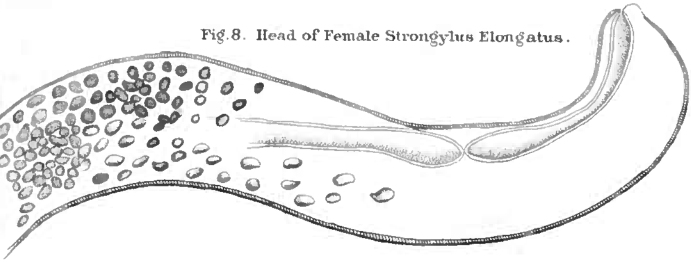


Fig. 6. Tail of Female Strongylus Elongatus.

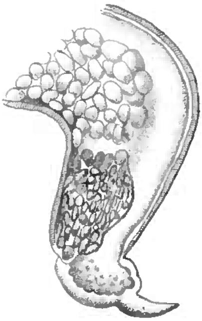


Fig. 7. Ova of Strongylus Elongatus.

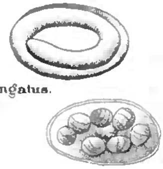


Fig. 10. Long and Short hooks of Taenia marginata × 240.

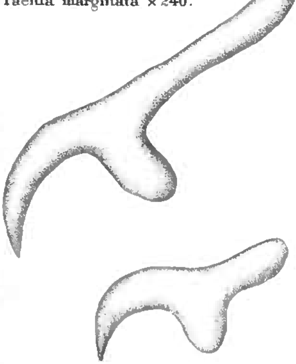
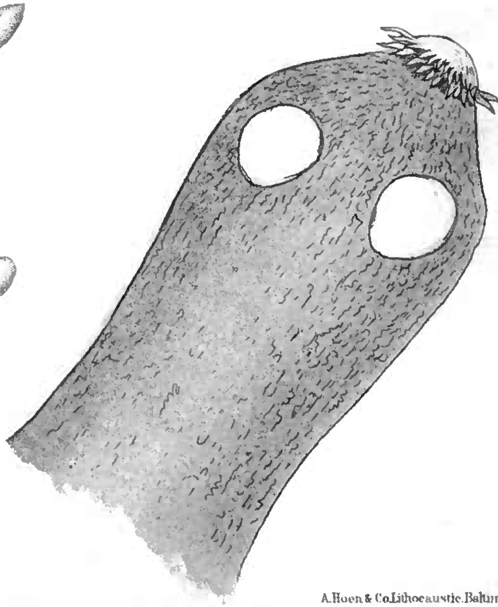


Fig. 9. Head of Taenia marginata × 50.



A. Hoen & Co. Lithocaustic. Baltimore.

by microscopic worms in the walls of the bowels, were, in all probability, the victims of an epizootic of *Sclerostomata.*

That the genuine hog-fever is not caused by either of these worms is best illustrated by the fact that in my second lot I found very few whip-worms and no *Sclerostomata*, though both were diligently sought for.

Cysticercus Zemicollis.—This *hydatid* I found in considerable numbers in the abdominal cavity (in the omentum, peritoneum, liver, kidneys, &c.), in the pelvis, perineum, and pleuræ of my first lot of pigs. It consists of an ovoid bag of liquid ½ to 1 inch in length, with an opening at one end, through which the head is drawn back into the sack. The head is supported on a very attenuated thread-like neck, whence the name. The membrane of the sack is marked by fine transverse striæ, and if placed in tepid water will often undergo active contractions, during which the head can be seen to rise and fall in the interior. The head and neck contain an abundance of dark calcareous particles, soluble with effervescence in a strong acid.

Seventeen of these *hydatids* were fed to a Newfoundland puppy, fresh from its mother, ten having been kept for some time in a solution of common salt, while seven were fresh from a newly-killed pig. After twenty-five days the puppy was sacrificed, and seven tapeworms (*Tænia Marginata*) were found attached by their hooked snouts to the mucous membrane of the jejunum. Exposure to a strong solution of common salt for less than a week in some cases had been sufficient to destroy the first ten, while all the seven cysticerci, grown fresh, developed into tapeworms. These had the globular head with four sucking disks and retractile proboscis, surrounded by a double row of 36 hooklets, having the characteristic long posterior process as shown in the accompanying lithograph (Plate XIV, Figs. 9 and 10); also the calcareous markings in the head and neck already referred to.

It is well known that when several ripe segments of this tapeworm are given to a sheep or goat, the myriads of resulting embryo worms that bore their way into the liver and other organs will give rise to such destructive changes in them that death may ensue in ten days. But here again we have the counter evidence in the entire absence of these parasites in my later lot of pigs, showing that they were in no way responsible for the specific hog-fever.

Other parasitic worms of swine.—It is needless to open up the question of the causation of this disease by the other worms of swine. Many years ago Dr. Fletcher called attention to the destructive effects of the *lard worm—Stephanurus Dentatus*—(misnamed *Sclerostoma Pinguicula*) on the liver and other internal organs, and even attributed the hog-cholera to its ravages. Doubtless he was dealing with an epizootic of this worm, but in many instances since, as in my own recent cases, this worm has been sought for in vain.

So with the *Trichina Spiralis*, the *Hook-headed Worm* (*Echinorhynchus Gigas*), the common measle *hydatid* (*Cysticercus Cellulosa*), and the liver flukes (*Fasciola Hepatica*, and *Distomum Lanciolatum*); however destructive they may be to pigs in infested localities, their entire absence in my experimental pigs sufficiently excludes them from the causation of the specific hog-fever.

EXPERIMENTS ON THE PROPAGATION OF THE DISEASE BY INOCULATION AND OTHERWISE.

Virulence of dried virus.—In experimenting on the hogs it was sought, first, to ascertain the tenacity of life of the dried virus. This was indi

cated three years ago by Professor Axe, who successfully inoculated a pig with virus that had remained dried upon ivory points for twenty-six days. It seemed important to test this by further experiment, as upon this question depends the weighty one of arresting or putting an end to the plague by the extinction of its poison.

Three pigs were inoculated with virulent products that had been dried on quills for ONE DAY, one with virus dried on the quill for FOUR DAYS, one for FIVE DAYS, and one for SIX DAYS. The quills had been sent from New Jersey and North Carolina, wrapped in a simple paper covering, and therefore not in any way specially protected against the action of the air. Of the six inoculations, four took effect, and in the two exceptional cases the quills had been treated with disinfectants before inoculation, so that the failure was to be expected.

Virulence of the dried intestine.—In the case of the quills, the virus was dried quickly on account of the tenuity of the layer, and no time was allowed for decomposition. With the diseased intestine the drying in the free air and sun was necessarily slower, and more time was allowed for septic changes. Three pigs were inoculated with diseased intestine which had been dried for THREE and FOUR DAYS respectively. In one case the diseased product was from North Carolina. In all three cases the inoculation proved successful. The morbid product, therefore, even in comparatively thick layers, may dry spontaneously, so as to be the means of transmitting the disease to the most distant States.

Virulence of the moist morbid product if secluded from the air.—A pig was inoculated with a portion of diseased intestine sent from Illinois in a closely corked bottle. The inoculating material had been THREE DAYS from the pig and smelt slightly putrid. The disease developed on the sixth day.

A second pig was inoculated with blood from a diseased pig that had been kept for eleven days at 100° Fahrenheit in an isolation apparatus, the outlets of which were plugged with cotton wool. Illness supervened in twenty-four hours.

The exclusion of air, or more probably the prevention or retardation of putrefaction, therefore, probably favors the longer preservation of the poison.

Probable non-virulence of morbid products that have undergone putrefaction.—Two pigs were inoculated in one day with the elements of an ulcer from a portion of intestine sent from New Jersey in a box. The product was TWO DAYS from the pig and distinctly putrid. Neither seemed to suffer at any time.

A third pig was placed in a pen with a portion of the same diseased intestine, and some manure sent with it. The intestine disappeared after the second day, and was probably eaten, but the pig showed no evil effects.

It should be stated that each of these pigs had been formerly inoculated, and two appeared to pass through a mild form of the disease, while the third had showed an elevated temperature on three alternate days only. It may therefore be questioned whether they had not attained to a certain degree of insusceptibility which insured the negative results. In other cases, however, I have found a second inoculation to take though the first had been successful, and Dr. Osler records cases of the same kind. The results obtained in the three above-mentioned pigs would demand further investigation in this direction, as they suggest a probable explanation of any varying virulence of the disease in wet and dry seasons, in sheds and in the fields.

If we can accept Dr. Klein's theory of the baccillar origin of the disease,

the harmless nature of thoroughly putrid products may be explained on the known principle that in preserved or cultivated products the propagation of the septic bacteria leads to the disappearance of the infecting ones.

Virulence of the blood.—A solitary experiment of Dr. Klein's having appeared to support the idea that the blood was non-virulent, I tested the matter by inoculating two pigs with the blood of one that had been sick for nine days. They sickened on the seventh and eighth days respectively, and from one of these the disease was still further propagated by inoculating the blood on three other animals as recorded below. It may, however, still be questioned whether the blood is virulent at all stages, as in the animals infected in the above experiments it was found to contain numerous actively moving bacteria, which had not been found in certain of the milder cases. This subject demands further inquiry.

Infection through the air.—Only one experiment was instituted on this subject. A healthy pig placed in a pen between two infected ones, and with the ventilating orifices within a foot of each other front and back, had an elevated temperature on the ninth, tenth, and eleventh days, with lameness in the right shoulder, evidently rheumatic. On the twenty-fourth day the temperature rose 2°, and remained 104° F. and upward for six days, when it slowly declined to the natural standard.

Infection of sheep, rabbit, and dog.—A merino wether, a tame rabbit, and a Newfoundland puppy were inoculated with blood and pleural fluid, containing numerous actively moving bacteria, taken from the right ventricle and pleura of a pig that had died the same morning. Next day the temperature of all three was elevated. In the puppy it became normal on the third day, but on the eighth day a large abscess formed in the seat of inoculation and burst. The rabbit had elevated temperature for eight days, lost appetite, became weak, and purged, and its blood contained myriads of the characteristic moving bacteria. The wether had his temperature raised for an equal length of time, and had bacteria in his blood, though not so abundantly. He did not seem to suffer materially in appetite or general health. The sheep and rabbit had been each unsuccessfully inoculated on two former occasions, with the blood of sick pigs, in which no moving bacteria had been detected. It remains to be seen whether the virus can be conveyed back to the pig and with what effect. Should further experiment show that other domestic animals than swine are subject to a mild form of the disease, and capable of thus conveying it and transmitting it with fatal effect to pigs at a distance, it will be a matter for the gravest consideration in all attempts to limit the spread of the malady or to secure its extinction. (Since the above was written, I have noticed that Dr. Klein has succeeded in transmitting the disease to rabbits, guinea-pigs, and mice.)

Results of disinfection and inoculation of diseased products.—Under this head eight experiments were conducted with as many different disinfectants, the morbid products being in every case such as had proved successful by direct inoculation on other swine. The object being to test first the most available and least expensive of the disinfectants, the virulent matters were treated with $\frac{1}{5}$ per cent. solution of each of the following agents: Bisulphite of soda, carbolic acid, sulphate of iron, chloride of zinc, and chloride of lime. The materials to be inoculated were in the thinnest layers, in four cases upon quills and in two in thin sections to be inserted under the skin. They were kept in contact with the disinfectants for five minutes, so that the virulent material was

thoroughly moistened, softened, and partially dissolved in the five cases in which a solution was used. In the sixth case the thin slice was only kept in the fumes of the burning sulphur for five minutes. In all cases a portion of the disinfectant was necessarily introduced into the wound along with the virulent agent. In four out of the six pigs the disease developed and ran its course as shown in the table, the disinfectants thus proving ineffectual being carbolic acid, sulphate of iron, sulphurous acid, and chloride of lime.

The pig inoculated with virus, treated with bisulphite of soda, died on the seventh day, evidently from lung-worms, and without any distinct symptoms of the plague. There remains the possibility that had it lived longer these would have appeared.

One agent only out of the six can be set down as having proved an efficient disinfectant as used, namely, the chloride of zinc. The virus, treated with this agent, produced no appreciable illness; and though the pig's temperature was raised on the fourth, sixth, and ninth days, this was probably accidental, as it showed no tendency to become permanent. Finally, two pigs were subjected to a hypodermic injection of a few drops of the blood of a diseased subject, mixed in a dram of a solution of permanganate of potassa for the one, and of bromide of ammonium for the other. Both inoculations took effect, and one of the pigs thus infected furnished the blood which conveyed disease to the sheep, rabbit, and dog, as recorded above.

NATURE OF THE HOG FEVER.

Though long confounded with *typhoid fever*, *anthrax* (*malignant pustule*), *erysipelas*, *measles*, *scarlatina*, &c., this malady is distinct from all of them. In my report for 1875 I pointed out my reasons for declining to recognize in it either of the above maladies, and claiming it to be "a disease *sui generis*"; and this position has been fully indorsed by the recent researches of Klein, Osler, and others, as well as by my own experiments. This affection may be defined as a specific, contagious fever of swine, characterized by a high but variable temperature, by congestion, exudation, ecchymosis, and ulceration of the intestinal mucous membrane, especially that of the cæcum and colon, and, to a less extent, of the stomach; by congestions and exudations in the lungs in the form of lobular pneumonia; by general heat and redness of the skin, the latter effaceable by pressure; by darker red and black spots unaffected by pressure; by a papular eruption and abundant dark sebaceous exudation; by ecchymosis on the mucous and serous membranes generally; by swelling and ecchymosis of the lymphatic glands; by irregularity of the bowels, costiveness alternating with a fetid diarrhea; and perhaps most important of all, by the presence of colonies of minute globular micrococci in the various seats of morbid change.

An experiment of Dr. Klein, in 1877, in which he cultivated the micrococcus for seven successive generations in the aqueous humor taken from the eyes of rabbits, using only a speck on the point of a needle to inoculate every new portion of the humor, and finally inoculated the product of the fifth and seventh generations successfully on two pigs, seems to establish that these microphytes are the ultimate cause of the disease. My own experiment, in which the disease was conveyed by blood that had been kept for eleven days in an incubator at the temperature of the body, goes to support the same conclusion; but I hope still to subject this question to a more crucial test. If we accept this hypothesis of the pathogenic action of the bacteria, it would almost of necessity follow

that the blood, the channel through which these must be carried to the various organs in which they are found, must prove virulent. One of Dr. Klein's experiments appears to negative this conclusion, whereas three of mine go to support it. From what we know of the generation of microphytes, it seems not improbable that at certain stages of its development this specimen may fail to be injurious, or more probably the germs may be filtered from the blood, being arrested in the capillaries, where they determine the morbid changes, and thus many specimens of blood may be obtained which are destitute of the morbid element, until that is again produced in abundance by proliferation in the tissues. By reference to my experiments, it will be seen that the blood with which the successful inoculations were made was taken from pigs in the last stage of the disease, or just after death. That the blood is virulent at certain stages is unquestionable, and in the nature of things this can scarcely fail to be the case, even if we were to set aside experiments and reach our decision from the lesions alone.

CAUSES.

It has been no part of my purpose to investigate the causes of this disease apart from the one specific cause of contagion. It was indeed impossible to pursue such a line of inquiry at a distance from any district where hogs are largely raised, where the disease prevails extensively, and where, presumably, new generations of the poison are taking place. One instance, however, of probable generation *de novo* has been brought under my notice, and the attendant circumstances were such that I think it important to publish the principal facts. In the end of April, 1871, Colonel Hoffmann, of Horseheads, purchased a large herd of swine to consume the buttermilk of his creamery. The swine were supplied with sheds, the open range of an orchard, with plenty of shade under the trees, on a gravelly soil, rising abruptly 10 to 15 feet above the general level of the valley, and were fed fresh buttermilk and corn meal. All went well until late in June or early in July, when the hogs began to sicken and died in large numbers, with the general symptoms of the hog fever. I have mentioned this mainly to negative the widespread belief that the source of the trouble is in the exclusive feeding upon corn. Here we had a laxative and otherwise model diet, supplemented only to a slight extent by corn. It may be well to state that in other years, when he has purchased Western hogs, the disease has always appeared within ten days or a fortnight after their arrival. When New York State hogs only have been bought the pestilence has not broken out.

In view of the strong assertions that pigs will not contract the disease when fed in part on green food or on succulent vegetables—turnips, beets, potatoes, apples, &c.—I had some subjects of experiment freely supplied with potatoes and apples, but whenever the poison was introduced by inoculation I could detect no difference in the period of incubation or the severity of the attack.

It may be added that all unwholesome conditions of feeding and management will favor the development of this as of other specific fevers, by deranging the nutrition, disturbing the balance of waste and repair, loading the blood and tissues with effete and abnormal products, raising the body temperature, and on the whole bringing about a state of the system extremely favorable to the propagation and growth of disease germs. But while the importance of all these may be recog-

nized as accessories, we must not allow them to withdraw our attention from the one condition essential to the development and propagation of the malady—the presence of the specific poison. To quote from my report of 1875, "The important point is this: We know this is a contagious affection, to the propagation of which all possible insalubrious conditions contribute. So soon as we concentrate our attention on this point we have the key to its prevention, if not to its entire extinction."

IS THE TREATMENT OF HOG FEVER GOOD POLICY?

In taking what I know to be an unpopular position on this subject, I am led by the strongest convictions of duty. I well know how popular would be an investigation into the curative powers of different systems, and even nostrums, in this disease, and how many breeders and dealers in swine will readily spend more than the value of the sick hog in the purchase of boasted specifics, to say nothing of the cost of attendance, and how they will rejoice over the wretched unthrifty animal whose life is at times preserved. It is not that recovery is impossible. A certain proportion, 20, 50, or even 80 per cent., will often survive. In my experimental cases only 21 per cent. died and over 28 per cent. recovered from the first attack, so that they were used for further experiment, and this without any attempt at medication or treatment further than wholesome food, cleanliness, and disinfection of the pens. I am convinced that a still better showing could be made in the majority of cases if the sick animals were submitted to careful and intelligent medical treatment.

Were the question of the preservation of the infected pig the only one or the main one to be considered, I would strongly advocate medicinal treatment. But the question is rather one of comparison between this one sick hog or herd and all the healthy swine in the same town, county, State, or nation. This is not a question of morality, but a problem in political economy, and when dealt with by a government must be decided on the ground of what is best for the whole nation. If, then, the preservation and treatment of a single sick hog means the incessant and incalculable increase in its body and secretions of a poison which is in the last degree deadly to other hogs; if this poison can be dried and preserved for a length of time, and carried meanwhile to a distance of a thousand miles, and if not hogs alone but sheep, guinea-pigs, and even wild animals like rabbits and mice, can contract the disease and convey the poison to any distance in their bodies, then the best interests of the nation demand that the sick animal shall not be preserved, but promptly sacrificed to the good of the community.

This point is so important that I may be permitted to dwell on it a little further. Some of my experimental pigs were successfully inoculated with quills that had been dipped in the morbid exudations of sick pigs in New Jersey and North Carolina, and had been dried and preserved for from one to six days in this condition. Here we had the thinnest possible film, such as might have adhered to the clothing of man, the hair of an animal, the feet or bill of a bird, the legs or prehensile organs of an insect, to a dried leaf, or even to a floating thistledown, and might have been thus carried in a great many different ways to infect distant herds. What was actually conveyed some hundred miles on a dried quill, and preserved its virulence for six days in this condition, can be as certainly preserved on any other dry object, and if brought by

accident in contact with a raw surface, will produce disease as surely as did the quills in my inoculations. My own observations in this respect have been more than corroborated by one of Professor Axe, of the Royal Veterinary College, London. He produced the disease by inoculating from ivory points on which the cutaneous exudation had been dried up for the long period of twenty-six days.

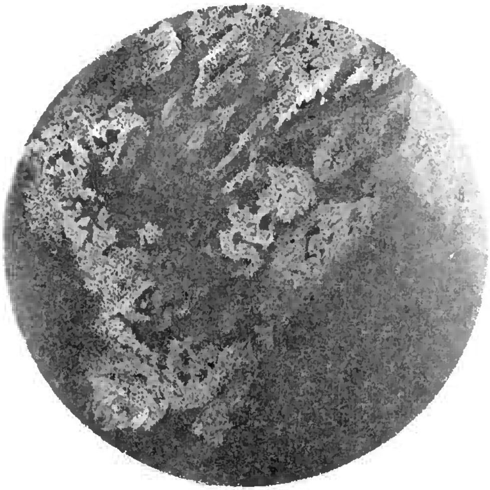
That the poison can be preserved even in the liquid state when the germs of putrefaction are excluded, may be inferred from my successful inoculations with blood that had been kept in an isolation apparatus, at the ordinary body temperature, for the period of eleven days. As directly to the point is the cultivation of the poison in aqueous humor for seven days, by Klein, and its subsequent successful inoculation. This experiment of Klein is, however, possessed of vastly greater importance, inasmuch as by it it was first shown that the poison can be cultivated and indefinitely increased out of the animal body as well as in it. On seven successive days he inoculated seven successive portions of aqueous humor with as much of the inoculated liquid of the previous day as would adhere to the point of a needle, the first having been similarly inoculated from the sick pig. From the cultivations of the fifth and seventh days, respectively, a drop was taken and two pigs were successfully inoculated therewith. In the cultivation of each day were found myriads of *bacillus*, but no other organization, and thus Klein was the first to show that the *bacillus* is the probable cause of the disease. Had there been no reproduction and increase of the poison, it must have been rendered inconceivably dilute, an approximate ratio of the poison added to the first day's cultivation, and that added to the last, being about as 1 is to 1,000,000,000,000,000,000. That such a dilution could be operative seems utterly incredible, and as modern research shows that virulence resides not in simple liquids, but in the solid particles contained in them, and as the only definite organisms in the cultivation liquids were the *bacilli*, it seems inevitable that these are the active cause of the disease. But if so, they cannot only be preserved, but increased in suitable fluids outside the animal body. It is true they disappear when the active organisms of ordinary putrefaction (*bacterium termo*) become numerous, but they are not necessarily destroyed. From what we know of the life of these mycrophytes it is to be feared that so far as the *bacillus* has advanced to the production of spores, it will be preserved in a dormant state, like so many dried seeds, until conditions favorable to its growth shall transpire. On the other hand it may be recollected that my attempts to propagate the disease from a putrefying bowel failed, so that further observation is wanted before we can say that the *bacillus* or its spores are preserved in a septic liquid. However that may be, the possibility of its increase in a non-septic normal fluid is an additional argument for the total destruction of all diseased pigs and morbid products.

In the case of high-priced pigs, where expense is no object, and where the patients can be kept in thoroughly disinfected pens, under the most rigid seclusion, treatment may sometimes be commendable; but in the case of common herds, and as viewed from the standpoint of the greatest good to the greatest number, there can be no question at all that the treatment of the sick is the most ruinous policy, while the most stringent measures for the extinction of the poison is the only economical one. The universal experience of veterinarians supports this conclusion, and nearly every European government has now reached the same conviction, and absolutely prevent the preservation and treatment of the victims of those fatal contagious diseases which most threaten their flocks and herds.

MEASURES TO ARREST AND EXTIRPATE THE DISEASE.

To put a stop to the ravages of the fever concerted measures are essential. One farmer may easily eradicate it from his own herds; but so long as his neighbors continue to harbor it his stock is daily subjected to the danger of renewed infection. His personal sacrifice is all in vain, so long as he is liable to have his herds infected by a chance visitor, a wandering animal or bird, or even a favorable wind. What is true of the individual farmer is equally true of the township, county, and State. One may crush out the disease at a cost of immense effort and outlay only to find it reappearing the next day, as the result of carelessness on the part of an adjoining or even distant State or district. In our Eastern States this plague is almost invariably the result of importation, and though from the lack of pigs it never gains a wide prevalence, it sufficiently illustrates how the disease is propagated in the West, where its more extended ravages are liable to blind the eyes to the fact. To secure a complete or even partial immunity active measures must be taken over the entire land, and while this cannot be done by States, districts, counties, or even towns, separately, it will be rendered the more effectual in the precise ratio that it is inaugurated as a uniform system over the entire country, and under one central controlling authority.

Without entering at this time into all the details of the necessary restrictive measures, the following may be especially mentioned: 1st. The appointment of a local authority and inspector to carry out the measures for the suppression of the disease. 2d. The injunction on all having the ownership or care of hogs, and upon all who may be called upon to advise concerning the same, or to treat them, to make known to such local authority all cases of real or suspected hog fever, under a penalty for every neglect of such injunction. 3d. The obligation of the local authority, under advice of a competent veterinary inspector, to see to the destruction of all pigs suffering from the plague, their deep burial in a secluded place, and the thorough disinfection of the premises, utensils, and persons. 4th. The thorough seclusion of all domestic animals that have been in contact with the sick pigs, and in the case of sheep and rabbits the destruction of the sick when this shall appear necessary. 5th. Unless, where all the pigs in the infected herd have been destroyed, the remainder should be placed on a register and examined daily by the inspector, so that the sick may be taken out and slaughtered on the appearance of the first signs of illness. 6th. Sheep and rabbits that have been in contact with the sick herd should also be registered, and any removal of such should be prohibited until one month after the last sick animal shall have been disposed of. 7th. All animals and birds, wild and tame, and all persons except those employed in the work, should be most carefully excluded from infected premises until these have been disinfected and can be considered safe. 8th. The losses sustained by the necessary slaughter of hogs should be made good to the owner to the extent of not more than two-thirds of the real value as assessed by competent and disinterested parties. 9th. Such reimbursement should be forfeited when an owner fails to notify the proper authorities of the existence of the disease, or to assist in carrying out the measures necessary for its suppression. 10th. A register should be drawn up of all pigs present on farms within a given area around the infected herd—say, one mile—and no removal of such animals should be allowed until the disease has been definitely suppressed, unless such removal is made by special license granted by the local authority after they have assured themselves by the examination of an expert that the

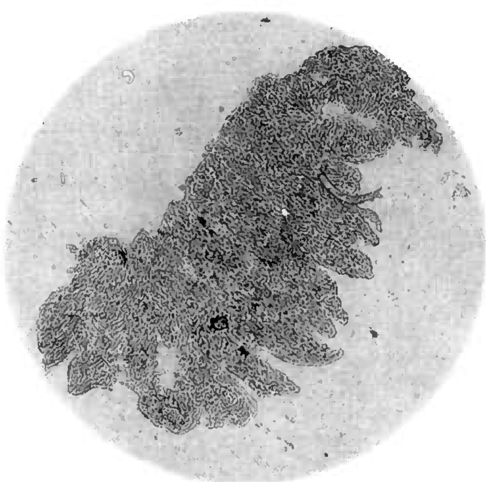


Microscopic section showing exudation in the cæcal mucous membrane beneath an ulcer.

Microscopic section through skin, showing hair follicle containing effused blood. The bristle was detached in mounting.

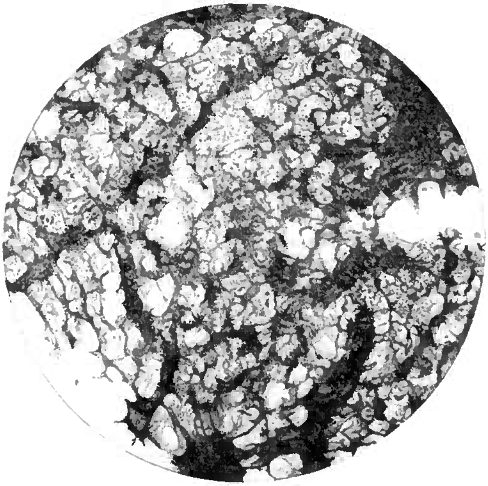
A.Hoen & Co.Lithocaustic.Baltimore.

Microscopic section of lung with exudate filling the air cells and thickening the alveolar walls.

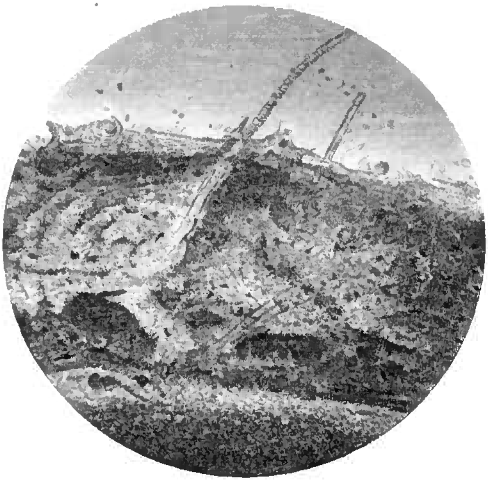


Microscopic section of congested gut, showing villi with excess of granular matter, stained in hæmatoxylon. Detached round cells.

A.Hoen & Co.Lithocaustic Baltimore



Microscopic section of lung, showing thickened walls of air-cells; blocked vessels; exudate into cell-walls, and a few of the cells.



Microscopic section from ear, showing cartilage and skin with broken surface, and crust-entangling bristles.

A. Hoen & Co. Lithocaustic. Baltimore

animals to be moved are sound and out of a healthy herd. 11th. Railroad and shipping agents at adjoining stations should be forbidden to ship pigs, excepting under license of the local authority, until the plague has been suppressed in the district. 12th. When infected pigs have been sent by rail, boat, or other mode of conveyance, measures should be taken to insure the thorough disinfection of such cars or conveyances, as well as the banks, docks, yards, and other places in or on which the diseased animals may have been turned.

Other measures would be essential in particular localities. Thus in the many places where the hogs are turned out as street scavengers and meet from all different localities, such liberty should be put a stop to whenever the disease appears in the district, and all hogs found at large should be rendered liable to summary seizure and destruction.

The great difficulty of putting in practice the means necessary to the extirpation of the disease will be found to consist in the lack of veterinary experts. No one but the accomplished veterinarian can be relied on to distinguish between the different communicable and destructive diseases of swine, and to adopt the measures necessary to their suppression in the different cases. In illustration I need only recall the numerous reports in which what is supposed to be hog cholera has been found to depend on *lung worms*, on any one of the four different kinds of *intestinal round worms*, on the *lard-worm*, on *embryo tape-worms*, on *malignant anthrax*, on *pneumonia*, or on *erysipelas*. To class all these as one and apply to all the same suppressive measures would be a simple waste of the public money, but to distinguish them and apply the proper antidote to each over a wide extent of territory would demand a number of experts whom it would be no easy matter to find. This state of things is the natural result of a persistent neglect of veterinary sanitary science and medicine as a factor in the national well-being, and must for a time prove a heavy incubus on all concerted efforts to restrict and stamp out our animal plagues. It will retard success under the best devised system, and will sometimes lead to losses that might have been saved, yet if an earnest and prolonged effort is made the obstacle should not be an insuperable one, and the United States should be purged not of this plague only, but of all those animal pestilences which at present threaten our future well-being.

Respectfully submitted.

JAMES LAW.

ITHACA, N. Y., *January* 2, 1879.

APPENDIX.

RECORD OF DR. LAW'S EXPERIMENTS.—No. 1.

Male white pig, eight months old; no special breed. Formerly fed offal from a slaughter-house

Date.		Hour.	Temperature of body.	Remarks.
Sept.	30	3 p. m.....	104.75° F.	Had escaped and was caught after a good chase.
Oct.	1	9 a. m.....	103.25	
	1	6 p. m.....	103.5	
	2	9.30 a. m..	102.5	
	3	9.30 a. m..	102	
	5	4 p. m.....	102.75	Inoculated from quill charged with dried liquid from infected lung; matter from North Carolina, and five days old; quill dipped five minutes in solution of bisulphite of soda—:1 :: 500.
	6	5 p. m.....	103.25	
	7	11 a. m....	100	
	8	12 noon...	101.5	
	9	11 a. m....	103.5	
	10	5 p. m.....	101.25	
	11	10 a. m....	102	
	12	4 p. m.....	99	

Was found sprawling upon its belly unable to stand; breathing slow, deep, panting, and labored; snout hot, dry, and of a leaden color; ears and feet warm, bluish, but without any rash, eruption, blotches, or extravasations. Blood appears at the arms. An hour later this pig died.

Post-mortem examination thirty-six hours after death.—Body in excellent preservation; condition low; skin scurfy along the back; snout livid blue, but without petechiæ.

Digestive organs: Tongue has papillæ, at its base reddened; a similar blush appears on the fauces and pharynx.

Stomach and bowels normal.

Liver firm and sound. Kidneys and bladder sound.

Urethra (intrapelvic) deeply congested, almost black, but without any obstruction.

Parasites in abdomen: A few *tricocephali* (*whip-worms*) in the large intestines; a *hydatid* in the pelvic fascia.

Chest: Pleura normal; *pericardium* healthy, with a small quantity of serum.

Right heart: Auricle and ventricle filled with dark clotted blood.

Left heart: Auricle contains a small clot of black blood; ventricle empty.

Lungs: A great part of these is in a condition of carnification or infarction. This is confined to definite lobules or groups of lobules, the collapsed, red, fleshy aspect of which is in marked contrast with the full form and pale pinkish-white color of the remainder.

The air passages (bronchi and bronchia) contain small portions of the contents of the stomach which have been vomited up and drawn into the lungs in the last violent efforts to breathe. The air-passages leading to the collapsed lobules contain large quantities of a watery mucus and pellets of worms (*strongylus elongatus*) which completely block them. The obstructed terminal bronchia are dilated, and have their mucous membrane variously reddened and congested. Around these bronchia the connective tissue is strongly congested and filled with extravasated lymph, by which the vessels passing to and from the lobuletts are compressed and obstructed. In view of this state of things, the explanation of the process of infarction in the lobules is easy; the irritation and congestion caused by the worms in the infested air-tubes extended to the surrounding connective tissue and the sheaths of the accompanying blood-vessels; the exudation of lymph compressed and obstructed the vessels, inducing stagnation, congestion, and exudation in the whole substance of the lobule or lobuletts to which these led. Hence the invariable connection of the infarcted lobule, and the blocked, congested, and worm-infested tube that led to it.

Experiment No. 2.

White male pig, eight weeks old, smallest of litter. Formerly fed offal at a slaughter-house.

Date.	Hour.	Temperature of body.	Remarks.
Sept. 30	3 p. m.	104. °F.	Has just come one mile in a wagon.
Oct. 1	9 a. m.	103.24	
1	6 p. m.	102.5	
2	9.30 a. m	102.	
3	....do	101.	
5	4 p. m.	102.	
6	5 p. m.	101.	
7	11 a. m.	100.75	Bowels quite loose; rain.
8	12 noon	102.	Inoculated from quill dipped in liquids of diseased lungs forty-eight hours ago in New Jersey; quill treated with chloride of zinc before inoculating.
9	11 a. m.	101.	
10	5 p. m.	103.25	
11	10 a. m.	101.5	
12	4 p. m.	105.25	
13	12 noon	102.75	
14	4 p. m.	104.	
15	10 a. m.	102.5	
16	....do	102.5	
17	....do	104.	
18	....do	102.5	
19	....do	103.3	
20	....do	103.	Scouring; placed in pen with semi-putrid ulcerated intestine and manure of diseased pig.
21	....do	102.	
22	....do	102.5	
23	....do	102.75	
24	....do	103.	
25	....do	101.	
26	....do	102.75	
27	....do	101.	
28	....do	102.25	
29	9.30 a. m	103.	
30	2 p. m.	100.5	
31	9 a. m.	102.5	
Nov. 1	10 a. m.	101.75	
3	9 a. m.	101.25	Inoculated with quill charged with liquid from lungs of pigs having no bowel lesions; sent from Indiana.
4	....do	102.	
5	9.30 a. m	101.	
6	10 a. m.	100.5	
7	....do	103.	
8	....do	100.9	
9	....do	100.5	
10	....do	103.5	Pining; gets lighter daily.
11	....do	102.9	
12	....do	103.	Wasting, but lively.
13	....do	102.5	
14	....do	102.2	
15	....do	102.8	
16	....do	102.5	
17	....do	102.	
18	....do	100.5	
19	....do	103.	
20	....do	102.	
21	....do	102.	
22	....do	101.75	
23	....do	100.5	
24	....do	100.5	
25	....do	97.5	
26	....do	98.	Very weak and exhausted; surface cold; breathing slow and rattling; left its bed, but was unable to get back without assistance. An hour later breathing seemed to have ceased, but when removed for dissection it returned in a gasping manner; killed by bleeding.

Post-mortem examination.—Skin: Pale, bloodless, withered, and inelastic, covered almost universally with black concretions or unhealthy-looking and thick, dirty, white scurf. Snout beneath the nostrils blue, but not ecchymosed.

Digestive organs: Tongue healthy; beneath the right tonsil is a considerable collection of dirty, grayish-yellow, cheesy matter, consisting of pus-cells and much granular matter.

Stomach: Moderately full, contents fetid and slightly acid, firmly adherent to the mucous membrane, and bringing off part of the epithelium when detached. The mu-

cous membrane on the great curvature is congested, and bears several patches of deep, blood-red extravasation.

Small intestines: Red and congested throughout. The contents are small in quantity and dry, being collected in dry masses at considerable intervals, and partly frothy. The duodenum and first half of the jejunum contains twenty-two ascarides (*A. Suilla*), one extending to 11 inches in length. At different points the bowel is completely blocked by the rolls of these worms.

Large intestine: Ilio-cæcal valve normal. Cæcum and colon, like the small intestine, congested throughout nearly its whole extent, with patches of extravasation and erosion at intervals, but none of the characteristic sloughs nor ulcers, with thick indurated base. The cæcum and upper portion of the colon contains thirteen whip-worms (*tricocephalus crenatus*), their heads firmly imbedded in the mucous membrane, and requiring considerable force to withdraw them.

Liver: Small and of healthy aspect. Gall-bladder full of a dark-green, tenacious bile. Spleen small, black, and somewhat soft. Pancreas normal. Mesenteric glands apparently little altered. Some were slightly congested.

Kidneys: Normal. In the prepuse is a slight, fetid, concretion-like false membrane. On the *omentum* are two *hydatids*.

Respiratory organs: The whole interior of the larynx is of a dull brownish-red, excepting where covered by an extensive false membrane. Along the upper wall of the windpipe, where the ends of the cartilages overlap, is a false membrane about a third of an inch in breadth, and extending from the larynx as far as the lungs. This has a firm consistency, and a dirty yellowish-white color, tinged with green, and stands out prominently from the adjacent mucous membrane by an abrupt margin on each side. Under the microscope it is seen to consist of large quantities of granular matter, granule cells, epithelial and pus corpuscles, blood globules, and numerous crystals. It also contains eggs of the lung-worm beneath this morbid product.

Lungs: Whole anterior lobe of the right lung carnified, of a deep-red color, and sinks in water. The special bronchus for this lobe, and its divisions, are filled with a tenacious mucus, but contain no worms. Several lobulettes in the anterior lobe of the left lung are in a similar condition. On the posterior border of each lung several lobulettes are consolidated, being of a dirty-gray color and semi-transparent. They present, in short, the appearance of pulmonary œdema. The bronchia leading to these lobulettes are completely filled with a thick mucus and numerous worms (*strongylus elongatus*) and their eggs.

The *bronchial lymphatic glands* appear normal.

Blood: The blood is very black, coagulates slowly but firmly, and without buffy coat, and has its globules full-sized and rounded. The right side of the heart beat, when touched, for nearly five hours after the death of the animal, and of its removal from the body.

EXPERIMENT No. 3.

White pig, eight weeks old; no special breed. Has been fed on raw offal at a slaughter-house.

Date.	Hour.	Temperature of body.	Remarks.
Sept. 30	3 p. m.	103.5° F.	Has just come a mile in a box-wagon.
Oct. 1	9 a. m.	103	
1	6 p. m.	102.5	
2	9 a. m.	101.5	
3	....do	101	
4			No observations.
5	4 p. m.	102.3	Blood taken from saphena vein for cultivation experiment; then inoculated with quill-point charged with liquid from diseased lung, five days old, from North Carolina.
6	5 p. m.	103	Slightly costive.
7	11 a. m.	100.75	Bowels natural.
8	12 noon	102.5	
9	11 a. m.	102.5	
10	5 p. m.	103	
11	10 a. m.	103	
12	4 p. m.	104	
13	12 noon	103	Dung very fetid.
14	4 p. m.	104.25	
15	10 a. m.	102.25	
16	....do	101.5	
17	....do	103.25	
18	....do	103	
19	....do	102.75	
20	....do	103	Inoculated with putrid intestinal ulcer from diseased pig in New Jersey. Fed a portion of same.
21	....do	100	
22	....do	101.5	
23	....do	102.25	

EXPERIMENT No. 3—Continued.

Date.	Hour.	Temperature of body.	Remarks.
Oct. 24	10 a. m	101° F.	Appears to suffer from introduction of thermometer.
25	....do	102. 5	
26	9 a. m	100. 5	
27	....do	101	
28	10 a. m	101. 5	
29	9.30 a. m	100. 75	
30	2 p. m	102. 25	
31	9 a. m	102. 5	
Nov. 1	10 a. m	101. 5	
2			No observations.
3	9 a. m	100. 25	Inoculated with dried diseased intestine sent from North Carolina. Dried in sun and air.
4	....do	101	
5	9.30 a. m	101. 75	
6	10 a. m	101. 75	
7	....do	103	
8	....do	102	
9	....do	100. 5	
10	....do	104. 5	
11	....do	102. 5	
12	....do	102. 5	
13	....do	103	
14	....do	103. 6	
15	....do	103	
16	....do	103. 5	Limited pink papular eruption on skin.
17	....do	103	
18	....do	103	
19	....do	103	
20	....do	102. 5	
21	....do	101	
22	....do	102. 5	
23	....do	102	
24	....do	101. 5	
25	....do	102	
26	....do	103	
27	....do	104	
28	....do	104	
29	....do	101. 75	
30			Killed by bleeding.

Post-mortem examination.—Skin: The seat of some papular eruption and black incrustations, but without any patches of purple.

Digestive organs: Mouth and throat sound.

Stomach: Is mottled, of a dark brown along the great curvature, but without any extravasations or erosions.

Small intestines: Has several limited patches of slight congestion, but no erosions. It consains twenty *ascarides.*

Large intestines: Shows some slight congestions, but no slough, erosion, or ulcer. A dozen whip-worms are present in the cæcum and colon.

Mesenteric lymphatic glands: Generally healthy, but a few were unusually red and congested near to the congested patches of the small intestines.

Hydatids: The abdomen contains eight of these.

Liver: Firm and of nearly a natural appearance.

Spleen and *pancreas:* Sound.

Kidneys: Have cortical substance blanched, but are firm and apparently sound.

Lungs: Have some lobulettes solidified red, impervious to air, and sinking in water. In the main terminal bronchia towards the posterior part of the lungs are numerous worms (*strongylus elongatus*), though not always in the air-tubes leading to the consolidated lobulettes.

Heart: Sound.

Brain: Sound.

EXPERIMENT No. 4.

White female pig, eight weeks old; no special breed. Formerly fed on raw offal at a slaughter-house.

Date.	Hour.	Temperature of body.	Remarks.
Sept. 30	3 p. m	103.75° F.	Just come one mile in a wagon.
Oct. 1	9 a. m	102.75	
1	6 p. m	104	
2	9.30 a. m	102	
3	....do	100.5	
5	4 p. m	102.	
6	5 p. m	101	
7	11 a. m	103	Bowels quite loose.
8	12 noon	101.5	Inoculated with quill charged with lung-fluids of a pig that had died suddenly in New Jersey. Virus one day on quill.
9	11 a. m	102.5	
10	5 p. m	104	
11	10 a. m	102.75	
12	4 p. m	104.5	
13	12 noon	103	
14	4 p. m	105.75	
15	10 a. m	105	
16	....do	104.5	
17	....do	107	
18	....do	106	
19	....do	104.25	Scouring. Cold north gale, rain and frost.
20	....do	105	Do.
21	....do	105.25	
22	....do	104	Skin covered with purple and black spots with red areola. The cuticle or black spots is dead and easily separated.
23	....do	105.25	
24	....do	105.75	Extensive purple blotches on ears, flanks, and abdomen, and a pink rash one to two lines in diameter; appetite poor.
24	5 p. m	105	
25	10 a. m	106	Killed to-day by bleeding.

Post-mortem examination.—Has been purging; feces fetid and bright yellow.

Skin: Nearly covered with black spots of from one to two lines in diameter, and evidently formed by sloughs or small necrotic patches of cuticle, infiltrated with blood and dried up. The median line of the belly between the rows of teats is almost devoid of these spots.

A purple rash in spots averaging one line across exists in different parts of the body, but is most abundant on snout, ears, buttocks, root of tail, and limbs, especially on the lower parts and inner sides. At certain points, as on the pendant half of the ears, on the hocks, in the région of the arms, and on part of the snout, there is a uniform leaden discoloration. The inner sides of the arms have similar but more circumscribed patches.

Digestive organs: A deep purple blush extends along the line of papillæ on the right border of the tongue. Similar spots exist in the posterior nares. Salivary glands are pale and normal. The guttural lymphatic glands have spots of congestion on their surface, but not extending into their interior.

Abdomen: No effusion. Three *hydatids* are found attached respectively to the posterior surface of the stomach, to the back of the liver, and to the mesocolon.

Stomach: Full of undigested food, yellow at pylorus. No marked congestion nor softening. No parasites.

Small intestine: Duodenum without extra vascularity; its epithelium gray, pigmented, and easily detached. Jejunum and ilium had circumscribed spots of congestion one-half inch in diameter on an average, and in one case slightly eroded.

Large intestine: Cæcum presents three ulcers, each one-fourth inch in diameter, having a circular elevated mass of dirty-white deposit, apparently non-vascular, and a very slightly reddened base. The matter on the surface of the ulcer consisted of cells, round, angular, and of other forms, much granular matter and myriads of round and linear moving bacteria. None of these ulcers appear to be situated on the solitary glands. The same remark applies to the congestions and erosions of the small intestines. Colon and rectum natural.

Parasites: The small intestines contain three *ascarides* (*A. Suilla*). The colon contains a young whip-worm (*tricocephalus crenatus*). The coats of the intestines at the points of congestion and elsewhere were carefully examined for parasites, but without result. The muscular tissue of the diaphragm was also examined in vain.

Liver: Two small cysts, each one-half line in length, exist on the middle lobe. They had thick fibrous walls and liquid contents in which the microscope detected cell forms.

The general substance of the liver is firm and natural, a few acini only isolated and in groups, being congested. The color predominates in the center of the acinus. The liver cells are granular.

Gall-bladder: Is full, but not to excess, with bright yellow bile. The bile-ducts in the liver are also full.

Pancreas: Normal, pink. Pancreatic lymphatic gland blotched; deep red on the surface.

Kidneys: Normal, unless it be in extra pallor of the cortical substance.

Chest: Heart, right auricle and ventricle contain clots showing a buffy coat. Left auricle and ventricle empty. A few petechia exist on the septum ventriculorum.

Lungs: Petechia exist on the pleura. A number of lobulettes are solidified or infarcted, and of a deep red flesh color. The bronchia leading to such lobulettes are blocked by numerous worms (*strongylus elongatus*) and their eggs, embedded in an abundant tenacious transparent mucus. In some cases the bronchia appear dilated, the mucous membrane conjested, and the epithelium degenerating, round and ovid granular cells predominating in its structure. There is no visible stasis (coagulation) of blood in the capillaries of the bronchia. The worms are confined to the smaller bronchia, and are only exceptionally found in the otherwise sound portions of the lungs.

Blood: That from the gluteal vein contains no bacteria nor free hæmatine so far as can be detected. Red globules are crenated and shrunken.

Experiment No. 5.

Female white pig, eight weeks old, no special breed. Formerly kept on raw offal at a slaughter-house.

Date.		Hour.	Temperature of body.	Remarks.
Sept.	30	3 p. m.	103.75° F.	Just brought one mile in a wagon.
Oct.	1	9 a. m.	103.75	
	1	6 p. m.	103	
	2	9 a. m.	102	
	3	9 a. m.	101.5	
	5	4 p. m.	102.25	
	6	5 p. m.	102	Inoculated with a quill dipped in liquids of diseased lung (five days old). Before the inoculation, quill was dipped ten seconds in solution of carbolic acid : 1 : : 500.
	7	11 a. m.	103	
	8	12 noon.	103.5	
	9	11 a. m.	103.75	
	10	5 p. m.	104	
	11	10 a. m.	105	Bowels natural. Lively.
	11	5 p. m.	105	Lively. Hungry.
	12	4 p. m.	103.75	
	13	12 noon.	104.3	
	14	4 p. m.	102.25	
	15	10 a. m.	104	
	16	....do	105	
	17	....do	104	Coughs.
	18	....do	104.25	Bowels loose. Feces fetid.
	19	....do	103.75	Scouring.
	20	....do	103	Inoculated with substance of a firm intestinal ulcer, sent from New Jersey, and slightly putrid.
	21	....do	102.75	
	22	....do	103.25	
	23	....do	103.75	
	24	....do	103	
	25	....do	102.25	
	26	9 a. m.	101	
	27	....do	102	
	28	10 a. m.	103	
	29	9.30 a. m.	102.75	
	30	2 p. m.	103	
	31	9 a. m.	103.75	A slight pink rash on skin.
Nov.	1	10 a. m.	101.5	
	3	9 a. m.	102	Inoculated with intestinal mucus and ulcer from Illinois, very slightly putrid.
	4	....do	100.75	
	5	9.30 a. m.	101.5	
	6	10 a. m.	101	
	7	....do	103.25	
	8	....do	102.5	
	9	....do	101	
	10	....do	104.75	
	11	....do	103.8	
	12	....do	102.75	
	13	....do	104	

EXPERIMENT No. 5—Continued.

Date.		Hour.	Temperature of body.	Remarks.
Nov.	14	10 a. m.	104 ° F.	Shedding black scales, leaving red conical papules.
	15	....do	103.75	Abundant pink papular eruption, excessive between the thighs.
	16	....do	103.8	
	17	....do	104	
	18	....do	104	
	19	....do	104	
	20	....do	103.75	
	21	....do	103.2	
	22	....do	103	
	23	....do	102.75	
	24	....do	103.2	
	25	....do	103.8	
	26	....do	104	
	27	....do	103.5	
	28	....do	104	
	29	....do	102	
	30	....do	103.2	
Dec.	1	....do	102	
	2	....do	103.2	
	3	....do	102.5	Killed by bleeding.

Post-mortem examination.—Skin: Presents many papules or slightly pink conical elevations, just raised enough to be felt by the finger; also black concretions like pin-heads and up to twice or thrice that size. It is, however, much cleaner than it was a week ago.

Digestive organs: Mouth normal, likewise the pharynx, larynx, and adjacent lymphatic glands.

Stomach: Has its mucous membrane dark brown along the great curvature, but without any extravasation, ulcer, or recent lesion.

Small intestines: Have a few spots of congestion, but these are very circumscribed. They contain twelve *ascarides*.

Large intestine: With few and slight patches of congestion. No enlargement of Peyer's patches, nor solitary glands; no erosions. The cæcum contains six whip-worms.

Lymphatic glands of the mesentery are mostly gray on the outside from pigmentary deposit, but normal in their interior. The pigmentation is evidently the result of a former blood extravasation, as is so constantly seen in the earlier stages of the disease. The blood coloring matter is being transformed into black pigment, as a concomitant of convalescence.

Liver: Presents several hard yellow concretions as large as peas, also spots and patches of purple. Similar rounded yellow concretions are found in the mesocolon. They are covered by a reticulated membrane, and are probably the remnant of some parasite. *Gall-bladder* very full (the pig had been killed fasting), bile green, glairy.

Spleen and *pancreas:* Normal.

Kidneys: One contains two *hydatids;* excepting marked pallor of the cortical substance they are otherwise normal.

Hydatids: Nine of these are found in different parts of the peritoneum.

Heart: Right side normal; contains a small clot.

Left ventricle: Has numerous patches of extravasation, of a deep claret color, situated mostly on the *carnæ columnæ* and *musculi papilaries.* These have their seat in and beneath the serous lining, and barely extended into the muscular substance. The margin of the bicuspid valve is slightly thickened.

Lungs: Have a very few red consolidated lobulettes; of the remainder many are only partially dilated, though they have nearly their normal color.

Parasites: The terminal main bronchium of the right lung contains from thirty to forty worms (*Strongylus elongatus*). The lobules corresponding to this bronchium were slightly collapsed, but not consolidated nor congested.

Lymphatic glands of chest almost unchanged.

Brain: Healthy.

A microscopic section from a petechia on the heart showed, in addition to the blocked capillaries and blood extravasations, a fine example of the curious ovoid parasites long known as Rainey's cysts.

EXPERIMENT No. 6.

Male white pig, eight weeks old; no special breed; has been hitherto fed raw offal at a slaughter-house.

Date.		Hour.	Temperature of body.	Remarks.
Sept.	30	3 p. m.	103° F.	Has just come one mile in a wagon.
Oct.	1	9 a. m.	103. 25	
	1	6 p. m.	103. 5	
	2	9.30 a. m.	101. 75	
	3	...do	101. 5	
	5	4 p. m.	102. 25	
	6	5 p. m.	100	
	7	11 a. m.	103. 25	
	8	12 noon	102. 25	Inoculated with quill dipped in pulmonary exudation of a pig that had been sick for a week or two. Infected quill sent from New Jersey.
	9	11 a. m.	101. 5	Rectum very red, and bleeds easily.
	10	5 p. m.	103. 75	
	11	10 a. m.	102	
	12	4 p. m.	102. 5	
	13	12 noon	102	
	14	4 p. m.	104	
	15	10 a. m.	103	
	16	...do	103	
	17	...do	101. 75	
	18	...do	103	
	19	...do	102	
	20	...do	102. 5	
	21	...do	103. 5	
	22	...do	105	
	23	...do	103. 5	
	24	...do	104	Shows extensive blue patches on ears, flanks, and belly; also a pink rash, spots one to two lines in diameter. Appetite impaired.
	24	5 p. m.	105	
	25	10 a. m.	105. 25	
	25	6 p. m.	105. 75	
	26	9 a. m.	105	Off feed, but active; ears partly purple; feces dark but moderately firm; struggles when the thermometer is used.
	26	p. m6.	104. 75	
	27	9 a. m.	105	Ears cold, livid in their outer half; pulse 120 per minute; breathing natural; is bright and feeds when up, but is inclined to lie, and shows much weakness; has always resented handling, but to-day, when caught, threw itself on its side and lay to have its temperature taken.
	28	10 a. m.	103. 5	Costive; dung in firm round balls, but of good color, and not specially offensive; runs around readily, but is weak; discoloration mainly on ears.
	29	9. 30 a. m.	104. 3	Still costive; ears cold and very blue.
	30	2 p. m.	106	Weak on limbs; ears very dark purple; legs, tail, and rump badly blotched; bowels costive; dung in yellow balls.
	31	9 a. m.	103. 75	Skin extensively blotched with dark purple; bowels costive; weak on limbs, especially the hind.
Nov.	1	10 a. m.	103. 75	Very weak; disinclined to move; sways on its hind limbs when up; bowels quite soft.
	3	9 a. m.	99. 75	Very dull; weak; evidently sinking; pulse 132 per minute; grits its teeth continually when up; breathing slow; nervous tremors and jerking constant.
	3	6 p. m.	99. 5	Evidently delirious; screams when its door is opened, or when approached or touched; stands with difficulty, having its hind feet drawn forward to the level of the fore, or in front of them; muscular jerking constant, and prevents us from taking the pulse; no grinding of teeth; has not eaten since morning.
	4	....	Found dead.	

Post-mortem examination, November 4.—*Skin:* Almost universally scarlet, passing to dark purple on ears, belly, and hocks. Inner sides of the fore-arms and thighs have the skin white, but blotched with indelible purple spots one-half to one line in breadth. Many of these spots have a dark red or purple areola, with a firm black central scab or slough, evidently resulting from extravasation into the cuticle and superficial layers of the true skin. A section made perpendicularly to the surface shows much redness from blocked branching blood-vessels, especially around the hair follicles, and numerous minute spots of blood extravasations.

The *snout* is of uniform dark red, but with deeper purple spots ineffaceable by pressure.

Margin of the arms deep purple, almost black.

Digestive organs: Tongue, left border has an extensive slough near the tip. Right border has a number of firm elevated points, with purple areola and yellow centers.

Soft palate: Lower or buccal surface has its follicles deeply stained with blood and surrounded with purple areola; some follicles are filled with a yellowish material.

Right tonsil: Is swollen and has its ducts distended with a thick, tenacious, transparent mucus, containing great numbers of rounded granular cells.

Throat: Epiglottis bears spots of congestion ineffaceable by pressure.

Gullet: Healthy.

Stomach: Moderately full; acid. The mucous membrane on the great curvature presents patches of extravasation and erosion, the latter varying from one to three lines in diameter. Contains a worm (*ascaris Suilla*).

Small intestine: Contains twelve *ascarides*, one as much as ten and one-eighth inches in length. The mucous membrane presents along its whole course patches of redness, congestion, and softening, which are especially numerous and extensive towards its lower portion.

Ilio-cæcal valve: Bears a sloughing ulcer completely encircling it.

Cæcum: Contains a number of ulcers with white sloughs, many of them confluent, and forming bands or belts tending to encircle the gut, being situated on the summits of the transverse folds.

Colon: The anterior portion is much ulcerated, some of the ulcers being confluent and tending to form transverse bands as in the cæcum, while others are mere circular masses, two or three lines in diameter, with white necrotic center, and very little vascularity around the margin.

Rectum: Has patches of congestion and extravasation one line and upwards in breadth; in the case of one, advanced to the formation of a firm white slough and ulcer as in the cæcum. Close to the anus the entire mucous membrane is very deeply congested and thickened by exudation and extravasation.

Parasite: The cæcum contained one whipworm (*Tricocephalus crenatus*).

Parasites in the peritoneum: In the cavity of the abdomen were found twelve *hydatids* in connection with the liver, stomach, omentum, mesentery, meso-colon, and pelvic fascia. Three others were lodged in the perineum near the urethra.

Kidneys: Softened slightly and of an unusual pallor in their cortical portion.

Bladder sound. Intrapelvic urethra deep red, almost black, from petechial extravasation.

Urine about two ounces, turbid, strongly acid, albuminous; density, 1020; urea, 2 per cent.

Chest: Heart has a gelatinoid material filling the auricula-ventricular groove similar to that seen in No. —.

Right heart has a considerable buffy clot in both auricle and ventricle. Left auricle contains a small clot, almost the entire substance of which is pale or buffy. It further contains some very dark fluid blood.

Lungs: A few lobulettes only are infarcted or consolidated. In all cases the bronchia leading to the consolidated lobulettes are blocked by worms (*S. elongatus*). The other bronchia are clear of worms excepting in the immediate vicinity of the infarcted lobulettes. The great bulk of the lung is healthy, and of a soft white color, slightly tinged with pink.

Parasites: Attached to the pleura were two *hydatids*.

EXPERIMENT No. 7.

Female pig, eight weeks old, no special breed. Formerly fed raw offal at a slaughter-house.

Date.	Hour.	Temperature of body.	Remarks.
Sept. 30	3 p. m......	103.75° F.	Has just come one mile in a wagon.
Oct. 1	9 a. m......	103.3	
1	6 p. m......	103	
2	9.30 a. m ..	102	
3	....do	100.75	
5	4 p. m......	102.2	
6	5 p. m......	103	Inoculated with quill charged with matter from diseased lung from New Jersey, six days old; quill treated with solution of copperas : 1 : : 500.
7	11 a. m.....	104	
8	12 noon	103.25	
9	11 a. m.....	104.20	
10	5 p. m......	103.25	
11	10 a. m.....	105.75	
11	5 p. m......	105.75	
12	4 p. m......	104	
13	12 noon	104	
14	4 p. m......	103.75	

EXPERIMENT No. 7—Continued.

Date.		Hour.	Temperature of body.	Remarks.
Oct.	15	11 a. m....	107° F.	Lively; good appetite.
	16	10 a. m....	105.75	
	17	....do	102.25	
	18	....do	104.25	
	19	....do	103	
	20	....do	103.75	Scouring.
	21	....do	104.75	
	22	....do	104.25	
	23	....do	105.50	
	24	....do	105	Shows blue patches on the rump and flank, and a red rash on belly.
	24	5 p. m.....	105.5	
	25	10 a. m....	106.5	Pulse 108 per minute. Will scarcely move from bed.
	25	6 p. m.....	104.75	Very dull; skin hot.
	26	9 a. m.....	103	Dull; lies much; does not struggle when handled; ears deep purple; bowels loose; dung fetid; skin cool.
	26	6 p. m.....	105.5	Dull, very hot skin.
	27	9 a. m.....	107	Skin very hot, hips stained with feces. Defecations semi-fluid, dark greenish, with clayey aspect, and fetid. Pulse 160 per minute. Breathing 28 per minute; deep, rather labored; wheezing inspiration, terminated by a snore. Can scarcely be roused, and crouches in the litter at once when released.
	28	10 a. m....	104.5	Scouring. Feces offensive. Lies constantly on belly. When lifted hangs helpless with no attempt at struggling. Discoloration is very marked on ears, snout, belly, and thighs.
	29	9.30 a. m ..	102.75	Ran from bed to avoid being caught, but hangs helpless in hands when lifted. Feces very soft; fetid. Skin more deeply colored than before, but cool.
	30	2 p. m.....	99.75	Very sick; stupid; stands constantly with fore limbs drawn back and hind advanced, so that all four feet meet. Flanks hollow. Skin on discolorations very deep purple, almost black on rump. Bowels loose. Fetid.
	31	9 a. m.....	94.5	Lies in stupor, with limbs and body jerking every instant. Breathing slow, sighing, rattling. Feces and urine discharged involuntarily, and have soaked the left (lower) thigh, which, in consequence, shows a much brighter red than the other parts of the body. The general surface, excepting some white patches inside the arms and thighs, was of a dark purple, almost black on the ears, snout, median line of the abdomen, rump, and hocks. Killed by bleeding.

Post-mortem examination.—Blood: Scanty; that from axillary vein is neutral or slightly alkaline. Red globules deeply crenated and shrunken very disproportionately to the white globules, which are large and rounded, but appear deficient in numbers : 1 : : 80.

Skin: Section of the blue skin of the ear shows cutis, cuticle, and bristle follicles deeply congested, most of the capillaries being blocked by coagulated blood, and microscopic extravasations appearing at short intervals. The red globules in this part are full, rounded, and of the usual size.

Digestive organs: Tongue has a series of white sloughs along its tip and right margin, resembling those of the intestines, being yellowish-white, laminated, non-vascular, and with very slight congestion and redness around them. Microscopically these sloughs are composed of epithelial cells with much granular matter. In one a central red spot presents stagnation and coagula in the capillaries and microscopic extravasations. It is manifest these form in the same manner with the sloughs in the intestines. Circumscribed spots of the mucous membrane become the seat of congestion, resulting in coagulation of the blood in the capillaries and exudation and extravasation alike into the epithelial and sub-epithelial layers, leading to thickening and induration of the deeper strata, and death of the more superficial ones.

Soft palate: The buccal or lower surface bears a similar slough, while many of its follicles are red, swollen, and filled with a yellowish-white (cheesy?) matter.

Throat: The laryngeal surface of the epiglottis is congested, the redness being ineffaceable by pressure. The mucous membrane on the back of the right arytenoid cartilage bears a four-lobed warty looking excrescence like a small pin's head, which, under the microscope, discloses only round granular cells and free granules.

Abdomen, Stomach: This contains a few ounces of half-digested food. This, together with the lower portion of the gullet, is of a deep yellow hue, apparently from regurgitated bile. No marked congestion of the mucous membrane.

Small intestine: Shows circumscribed spots and patches of congestion and small petechia, but no erosions.

Large intestine: One sloughing ulcer on the ilio-cæcal valve, three on the cæcum, and a considerable number in the colon. The colon and rectum also bore numerous patches of extravasation one to two lines in diameter. The last inch of the rectum is of an uniformly deep dark red. The mucosa and sub-mucosa are alike gorged with blood, and at one point a bleeding pile projects into the passage.

Liver, pancreas, and spleen are firm and seemingly healthy.

Kidneys: Firm and apparently sound; cortical part rather pale.

Bladder: Sound; moderately full.

Urine: Strongly acid; density, 1026; albuminous; urea, $3\frac{21}{100}$ per cent.

Parasites in abdomen: Attached to the peritoneum of stomach, liver, and spleen are seven *hydatids.*

Chest: Right heart contains clots; left heart empty. Auriculo-ventricular furrow filled with a gelatinoid material, which, under the microscope, appears as a loose fibrous stroma, its open meshes filled with a nearly homogeneous material, together with a few fat cells, granule cells, and abundant capillary net-work filled with uncoagulated blood. The white corpuscles are more abundant in these than in the axillary vein. No parasites nor ova could be found in this gelatinoid material.

Lungs: Mostly healthy. Isolated lobules and at certain points a few adjacent ones are infarcted and solid, and all such have their bronchia filled with worms (*Strongylus elongatus*) and a thick mucous. The plugged bronchia are mostly dilated, and on the mucous membrane of one such is a white patch about a line in diameter, resembling the sloughs on the intestines, but not so thick.

EXPERIMENT No. 8.

White pig, eight weeks old; common breed. Formerly fed raw offal.

Date.		Hour.	Temperature of body.	Remarks.
Sept.	30	3 p. m	104° F.	Just come a mile in a wagon.
Oct.	1	9 a. m	103	
	1	6 p. m	103	
	2	9.30 a. m	101.5	
	3	9 a. m	101	
	4	(*)	(*)	
	5	4 p. m	98.75	Pigs in next two pens inoculated. Was found between door and bars, where it could not move.
	6	5 p. m	99	Again between door and bars.
	7	11 a. m	99	Costive.
	8	12 noon	101	
	9	11 a. m	104.5	Still very costive.
	10	5 p. m	102.75	Bowels natural.
	11	10 a. m	102.5	
	12	4 p. m	103.25	
	13	12 noon	103	Feces fetid.
	14	4 p. m	104	
	15	10 a. m	105	Lame in right fore limb.
	16	do	104.25	
	17	do	103.5	
	18	do	101.5	Scours. Feces fetid.
	19	do	102.5	
	20	do	103.75	Pigs in adjacent pens reinoculated.
	21	do	104.25	
	22	do	103.5	
	23	do	103.75	
	24	do	103	
	25	do	103	Placed in new pen, with infected pen on each side.
	26	do	103	
	27	9 a. m	103	
	28	10 a. m	103	
	29	9.30 a. m	105.3	Slight cutaneous rash
	30	2 p. m	104	Lively.
	31	9 a. m	104.2	No skin eruption.
Nov.	1	10 a. m	105.75	Still looks well.
	3	9 a. m	104.8	Stiff in hind limbs.
	3	6 p. m	104	
	4	9 a. m	103	Placed in pen just vacated by dead pig.
	5	9.30 a. m	101	
	6	10 a. m	103.5	
	7	do	102.75	
	8	do	102.6	Dull; no appetite; skin covered with black spots one-third to one line in diameter. Right ear has purple spots. Killed by bleeding.

*No observation.

Post-mortem examination.—Skin: Nearly covered with black spots from one-third to one line in diameter, consisting of minute sloughs of epidermis, infiltrated and discolored with blood. In a number of these the subjacent layers of true skin are congested,

and even the seat of microscopic extravasations of blood, while in some cases the black necrotic cuticle is covered by a dried crust of exuded lymph of a dark brown color.

The right ear is of a deep purple color, and purple patches of various sizes are found inside forearms and thighs, on the hocks, and beneath the chest. In these purple patches the true skin is the seat of extensive congestion with stagnation and coagulation of the blood in many of the capillaries, and numerous microscopic clots of extravasated blood, while all the tissues are stained with hæmatine.

Blood: That from the jugular is very dark and forms slowly a soft diffluent clot; red globules round and large. That from the carotid is crimson, and clots quickly and firmly; red globules crenate, small and shrunken. Blood from both vessels is slightly alkaline.

Tongue: On the posterior third of the right border is a purple spot one-half line in diameter, which cannot be effaced by pressure. Under the microscope this shows the same congestion and microscopic extravasations with the spots on the skin. The conical papillæ on the upper surface of the organ near its base have their tips of a very deep purplish red.

Larynx: There is purple punctiform discoloration on the posterior surface of the epiglottis, which cannot be removed by pressure.

Lymphatic glands: Those around the throat are deeply stained with blood, some only superficially and some throughout. This is true also of the glands of the chest, groin, and abdomen, but especially of the mesentery. In several cases the glands appear to be enlarged. Microscopically, they present congested capillaries filled with coagulated blood, minute extravasations, and a profusion of granules and granular cells.

Abdomen—parasites in peritoneum: Two *hydatids* were found respectively in the omentum and mesentery.

Stomach: Well filled; great curvature of a deep dark red; contents strongly acid.

Small intestine: Congested in some parts, but with no observed extravasation nor deep discoloration; contents not abundant, but at intervals stained of a deep biliary yellow, and with excess of mucus throughout.

Ilio-cæcal valve: With Peyer's follicles dilated, and contents in some slightly yellowish.

Cæcum: Close to the ilio-cæcal valve a considerable erosion, with raised center and margin, but no excess of vascularity.

Colon: Six inches from the cæcum is a sloughing ulcer, one and one-half lines in diameter, raised above the adjacent membrane, the superficial layers being of a dirty white color in the center, and non-vascular, while around the margin of the ulcer is no marked redness.

Liver, colon, and rectum: Several extravasation patches averaging one line in diameter, bright red, and evidently quite recent.

No intestinal parasites.

Liver: Firm; solid; considerable portions are of a deep purple hue, the deep coloration being mostly confined to the center of the acini.

Kidneys: Cortical portion soft and of a very light brown, almost parboiled, appearance. Papillæ and medullary parts of a very deep red.

Muscles: Contained no parasites.

Brain: Normal.

EXPERIMENT No. 9.

Female pig, eight weeks old; breed, Chester White.

Date.	Hour.	Temperature of body.	Remarks.
Nov. 5	9.30 a. m	103.75° F.	
6	10 a. m	103.75	
7	....do	103.75	Inoculated with part of small intestine of pig that died November 4, the virulent product having first been brought for five minutes in contact with a solution of chloride of lime (:1::500).
8	....do	100.75	
9	....do	101	
10	....do	104	
11	....do	105	
12	....do	105	Costive.
13	....do	104	Bowels loose.
14	....do	103.8	
15	....do	104.6	
16	....do	104.75	
17	....do	104	Scours.
18	....do	105	
19	....do	105	
20	....do	105	Skin hot.
21	....do	106	Killed by bleeding.

Post-mortem examination, November 21, 11 *a. m.*—Body in good condition.

Skin: Almost devoid of eruption. The ears alone present increased vascularity, with a moderate blush and excess of scurf.

Digestive organs: Natural above the stomach. Guttural lymphatic glands in part congested and the seat of microscopic blood extravasations. Stomach mottled of a deep brown for a span of two and one-half inches by three inches along the mucous membrane, covering its greater curvature. Contents abundant, intensely acid, and fumes with ammonia.

Duodenum: Bears a small erosion near the pylorus.

Jejunum and ilium: Have patches of congestion and microscopic extravasation at intervals.

Ilio-cœcal valve: Has its edges thickened and of a dark bluish gray. Many follicles in Peyer's patch covering the valve are distended with a yellowish-white product, but there is no extra vascularity nor erosion.

Cœcum, colon, and rectum: Bear at intervals patches of congestion and microscopic extravasation in the mucous and submucous layers, over which the epithelial layer is softened and easily detached. No ulcers are found.

Liver: Discolored in parts by blue punctiform spots involving individual acini or several adjacent ones. Toward the lower margin of the gland the deep redness is mostly confined to the center of the acini.

Spleen: Seems large, but not unduly gorged with blood nor softened.

Pancreas: Healthy.

Kidneys: Pale in their cortical part, present punctiform petechiæ on the medullary portion and papillæ.

Bladder: Empty and normal. Ovaries and womb sound.

The mesenteric, sublumbar, and inguinal lymphatic glands appeared enlarged and more or less stained, of a deep blood-red color.

Parasites in the abdomen: Two ascarides in the small intestine; one *tricocephalus* in the cæcum.

Lungs: Present numerous congested lobules varying in color from brownish pink to a dark purple (almost black). The bronchia leading to these lobules are pervious and without parasites. The congested lobules seem less solid than when worms have been present.

Heart and pericardium: Normal.

Brain: Sound. Dura mater bears four patches of extravasation on the right side near the vertex. The average breadth of these is one line.

Spinal cord: Sound; subarachnoid fluid, about two drachms.

EXPERIMENT No. 10.

White male pig, eight weeks old; breed, Chester White; condition, fine.

Date.	Hour.	Temperature of body.	Remarks.
Nov. 4	12 noon		Inoculated with mucus and congested and softened mucous membrane of the small intestines of No. —, found dead this morning.
5	9.30 a. m	104.75° F.	
6	10 a. m	103.75	
7	....do	103.8	
8	....do	103.75	
9	....do	102.5	
10	....do	104.5	
11	....do	103.5	
12	....do	104	Ears red.
13	....do	104.5	
14	....do	105	
15	....do	105.1	Losing condition. The skin shows the customary black necrotic spots of epidermis. Ears blue at edges.
15	3 p. m	103.5	Respiration 36. Killed by bleeding.

Post-mortem examination.—*Skin:* Slight eruption on the ears and blueness on the margins.

Digestive organs: No lesions in the mouth or pharynx.

Pharyngeal lymphatic glands: Stained of a deep blood-red color.

Stomach: Well filled with food. Contents strongly acid. On the great curvature a space of two and one-half inches square has a brownish mottled discoloration, and numerous deeper brownish markings, as if from altered hæmatine.

Small intestine: Epithelium is thick, soft, and easily detached. Contents liquid, with a great excess of mucus. The bowel is reddened and congested around its entire

periphery, and for a considerable distance at intervals, the congested portions being mostly empty and contracted.

Ilio-cæcal valve: Peyer's patch, which passes over the valve, has many of its follicles filled up with a yellowish-white matter. The whole patch is swollen, but not very vascular to the naked eye.

Cæcum and colon bear petechiæ: Many solitary glands in the colon are unusually large; some excessively dilated, filled with yellowish matter, and apparently commencing to form ulcers. Spots of congestion scattered over the mucous membrane show minute extravasations when placed under the microscope.

Mesenteric glands: Some unchanged; some stained of a deep blood color. Inguinal glands large.

Kidneys: Normal.

Liver: Is firm and solid. Bears numerous punctiform petechiæ on the posterior surface of its right lobe, and a large dark-purple patch on the posterior aspect of its middle lobe.

Gall bladder: Moderately filled with a straw-colored, glutinous bile. Membranes of the bladder unchanged.

Pancreas and spleen: Normal.

Chest—heart: Left ventricle contains petechiæ. Right auricle just above the auriculo-ventricular valve presents a brownish-red spot which, under the microscope, is seen to contain much granular matter in the sub-serous connective tissue.

Lungs: The right has two dark, blood-colored spots on its posterior part. The left shows similar colorations, mostly in lines along the inter-lobular spaces. The bronchia leading to such points contained no parasites nor exudation.

Bronchial lymphatic glands: Normal.

Brain: Normal.

EXPERIMENT No. 11.

White male pig, eight weeks old; breed, Chester White.

Date.	Hour.	Temperature of body.	Remarks.
Nov. 5	9.30 a. m....	102.75° F.	
6	10 a. m......	103	
7	....do	102	Inoculated with small intestine of pig that died November 4 the gut having been fumigated five minutes with sulphurous acid.
8	....do	100.5	
9	....do	100.75	
10	....do	101.75	
11	....do	104.5	
12	....do	102.5	
13	....do	103.5	
14	....do	103.5	
15	....do	103.25	
16	....do	104.75	
17	....do	102.75	Scouring.
18	....do	104.5	Fetid scouring.
19	....do	104.5	
20	....do	105	Feces still soft; unusually fetid; skin hot.
21	....do	105	
22	....do	103	
23	....do	103.75	
24	....do	103.3	
25	....do	104	
26	....do	104.25	
27	....do	103	
28	....do	104	
29	....do	103.5	
30	....do	103	
Dec. 1	....do	102.5	Red ears; dull; thriftless.
2	....do	103.2	
3	....do	102.25	
4	....do	100.75	Scours.
4	5 p. m......	102	
5	9.30 a. m....	102.25	
6	....do	102.5	Killed by bleeding.

Post-mortem examination.—Skin: In great part covered by the usual black concretion. Has patches of purple on ears and legs.

Digestive organs: Some deposit exists on the lower surface of the tongue, to the left of the frenum, composed of granular matter and cells having more than one nucleus; evidently the remnant of a small abscess. On the fauces, to the right side, is a purple patch not removed by pressure, extending to an inch in length and a quarter of an inch in breadth.

Pharynx and larynx: Normal.

Stomach: Full; contents moderately acid. Shows the usual brownish discoloration of the mucous membrane covering the great curvature.

Small intestines: Show only a few patches of congestion. The follicles of Peyer's patch just above the ilio-cæcal valve are considerably enlarged.

Large intestines: Show a great many enlarged solitary glands, yet but little congestion. The rectum is much congested and presents two ulcers: one with raised edges and raw, depressed center; the other, with a firm, dirty-white slough in the center.

Mesenteric lymphatic glands: Enlarged and thickly streaked with gray. Those near the ilio-cæcal valve, and those above the rectum, are congested and deeply reddened.

Inguinal glands: Are also greatly enlarged and streaked dark-gray with pigment.

Liver: Of normal consistency and color, excepting some few patches of deep purple. Gall-bladder moderately filled with a yellowish-green, viscid bile.

Pancreas: Healthy.

Spleen: A portion very dark colored (nearly black) extending its whole length and about half its breadth; is evidently gorged with blood; but is not raised above the level of the remaining part.

Kidneys: One contains an acephalocyst in its pelvis. The cortical substance of both is pallid, but no other change is noticeable.

The *lungs, heart,* and *brain* appeared healthy.

EXPERIMENT No. 12.

Male pig, eight weeks old; breed, Chester White.

Date.		Hour.	Temperature of body.	Remarks.
Nov.	19	10 a. m....	104.5° F.	Costive. Inoculated with blood of sick pig (No. 1) after treating the same with a solution of bromide of ammonia: 1::500.
	20	....do	104.75	
	21	....do	104.2	
	22	....do	104.75	
	23	....do	104.2	
	24	....do	103.8	
	25	....do	104	
	26	....do	104.3	
	27	....do	105.75	
	28	....do	105.75	
	29	....do	105.75	
	30	....do	106	
Dec.	1	... do	106.2	Edges of ears purple. Purple spots on scrotum.
	2	....do	106	Right ear a deep purple, bleeding at the point where exudation had formed a black scab.
	3	....do	105	
	4	....do	105	Ears blue; skin has purple blotches only partially effaceable by pressure. Feces liquid; yellowish white.
	4	5 p. m.....	105	
	5	10 a. m....	105	
	6	....do	101	Very prostrate; can barely rise.
	7	....do	....	Found dead in pen this morning.

Post-mortem examination.—Skin: Of ears, throat, breast, belly, and legs, of a uniform dark purple; white patches remain inside the forearm and thigh, and along the back, which is covered by a very thick scurf. The discoloration which is due to congestion of capillary vessels, the coagulation of blood within them, and numerous minute extravasations, is confined to the integument. The skin is also abundantly covered with the usual black concretions.

Digestive organs: Tongue blue, but with no abrasions.

Tonsils, fauces, and pharynx: The seat of general congestion and discoloration. Œsophagus has some spots of slight congestion.

Stomach: Distended with solid food; not so strongly acid as in many other cases. Its great curvature has the mucous membrane covered with patches of blood extravasation, such patches standing out in greater part as dark-red clots.

Small intestine: Exceedingly contracted, almost empty, and congested throughout in varying degree, from a simple branching redness, with softening of the mucous membrane and excessive production of mucus, to distinct circumscribed extravasations with decided thickening; in several instances the redness and the thickening is most marked on Peyer's patches. The duodenum contains three *ascarides.* Several small ulcers exist just above the ilio-cæcal valve.

Large intestine: Cæcum remarkably small and contracted. Neither cæcum nor colon contains much ingesta. The mucous membrane along the whole large intestine is inflamed, greatly thickened by exudation, and thrown into prominent circular folds. Its general color is of a dark brownish red, in many points verging upon black. At different points it shows the characteristic ulcers with a firm, dirty, white slough in the center of each, but these have in no case attained a large size, nor any marked thickening nor induration of their base, and without special care in the examination

might be easily overlooked. The rectum contains numerous blood extravasations and some considerable ulcers with the central whitish necrosed portions.

Mesenteric glands: Almost universally enlarged and of a deep red, from congestion and extravasation.

Liver: Of a very deep purplish brown, gorged with blood, but not materially softened nor moderately friable. It is especially dark near the margin of the lobes.

Gall-bladder: Moderately full, bile dark green and viscid.

Pancreas: Sound.

Spleen: Enlarged, gorged with blood, and almost black.

Kidneys: Nearly normal as examined externally. Corticle substance of a darker red than in most of the diseased pigs, and the papillæ bear black extravasations, punctiform and up to half a line in breadth. The right kidney contains a small cyst in its pelvis.

Left supra-renal capsule is enlarged to about one-third the size of the kidney, and has a clot of blood and a collection of cheesy matter superposed in its anterior end.

Lungs: Nearly normal; some congestion in the posterior lobes is evidently quite recent, and the cut surface freely exudes a frothy liquid.

Heart: Right ventricle slightly discolored by punctiform petechiæ beneath the endocardium. The great aorta contains a very firm clot, partly buffed.

Blood under a No. 10 Hartnack immersion shows no moving bacteria, but a great excess of granular matter.

Experiment No. 13.

White female pig, eight weeks old; breed, Chester White.

Date.	Hour.	Temperature of body.	Remarks.
Nov. 19	10 a. m	105.5° F.	Inoculated with the blood of sick pig No. —, five drops being mixed with a drachm of a watery solution of potassium permanganate (:1::500) and injected.
20	....do	104	
21	....do	103.25	
22	....do	103	
23	....do	104.75	
24	....do	103.25	
25	....do	104	
26	....do	104.8	
27	....do	104.75	
28	....do	104.5	
29	....do	104.75	
30	....do	105.3	
Dec. 1	....do	105	Deep-red ears; black concretions on skin.
2	....do	105.3	
3	....do	104.25	
4	....do	104.5	Stiff, unsteady gait; humped back; blue ears; costive.
4	5 p. m	103.5	
5	10 a. m	103.5	
6	....do	105	
7	....do	102.5	
8	....do	105	
8	6 p. m	104	
9	9.30 a. m	104	
10	....do	105	
10	4.30 p. m	104.5	
11	9.30 a. m	104	Very dull and quiet.
11	5.30 p. m	103.5	
12	10 a. m	107.75	Very languid and prostrate.
12	5 p. m	107.75	Does not rise when handled; breathing 28 per minute.
13	11 a. m	107	Feces soft, fetid, yellowish. Pig very prostrate, eats nothing, and scarcely moves when pricked to obtain a drop of blood. Blood contains moving bacteria.
13	5 p. m	107	

Pig found dead on the morning of December 14.

Post-mortem examination.—Skin: Blue spots on the belly, legs, rump, perineum, and ears. Free portions of the ears of a dark purple. Pink papillary eruption, and black concretions on the ears.

Digestive organs: Tongue has an ulcer, with slough a little to the left of the tip—size one and a half lines in diameter.

Tonsils and soft palate: The seat of a uniform bluish congestion. Submaxillary lymphatic glands in part reddened and congested.

Gullet: Contains clots of a stringy, fibrinous material.

Stomach: Near the left *cul de sac* is a dirty, yellowish-white false membrane of about one inch square. The great curvature is of a dark-brownish red, with some brighter red spots of more recent blood extravasation.

Small intestines: Nearly empty, though at intervals were round, hard pellets of in-

gesta. The coats of this bowel were more or less congested, with softening of the membrane at different points.

A large ulcer is forming on the edge of the ilio-cæcal valve, in which the outline of the follicles can still be seen of a yellowish color.

Large intestines: Cæcum and colon congested throughout, but much more at some points than at others. In the upper part of the colon are extensive deposits of false membrane of a dirty yellowish-white color, in places in spots of small size, and in others in extended patches of several inches in length. The cæcum has smaller spots of the same kind. The rectum is very much thickened and of a deep red throughout, the thickening existing mainly in the mucous membrane. It presents, further, nine small ulcers, with the characteristic dirty sloughs in the centers.

Parasites: The cæcum contains one whip-worm.

Liver: In the main firm, but contains bluish patches.

Pancreas: Apparently unchanged.

Spleen: Black, full of blood, but not apparently enlarged.

Mesenteric and sublumbar lymphatic glands: Are almost universally of a dark red, almost black color.

The left kidney: Has a cyst one-half inch in diameter in the anterior part of its pelvis. In common with the right kidney, it also presents numerous black petechia on the medullary portions and papillæ.

Chest and respiratory organs: Larynx shows considerable congestion, especially on the epiglottis and on the arytenoid cartilages.

Pleuræ: Contained an abundant blood-colored liquid exudation, especially in the right sac, where the lung had contracted extensive adhesions by newly-formed false membranes. The liquid effusion contained numerous white and red blood lobules and actively-moving bacteria, which assumed the most varied forms in rapid succession. A loose coagulum forms in the exposed fluid.

Bronchia: Filled with froth having a perceptibly pink tint.

Left lung: Anterior lobes congested and consolidated by recent exudation. Posterior layer lobe sound.

Right lobe: Consolidated throughout; sinks in water; but has not yet become firm, granular, nor friable. The color of this lung varies from a light brick-red to a deep red, approaching black, the darker shades mostly occupying the spaces of connective tissue between the lobules, these spaces being often stretched by the exudation to the breadth of a line or more. On making a section of the lung a considerable pulmonary vein was found to contain a friable granular grayish clot which had evidently existed for some time before death.

Pericardium: Contains a large amount of blood-colored effusion, in which blood-globules and moving bacteria abound. The parietal and visceral layers were connected by loose false membranes. Loose dark clots and some fluid blood existed in the right side of the heart, and spots of extravasation on the walls of the left ventricle.

Lymphatic glands: In the region of the throat are of a very deep red. The same remark applies to the bronchial and subdorsal glands.

Table showing the duration of incubation in different cases.

No.	Inoculated.	Apparently ill.	Duration of incubation, in days.	Percentage on different days.	Remarks.
1	Nov. 19	Nov. 20	1	6.6″	Inoculated with old blood that had been kept eleven days in an incubator.
2	Oct. 6	Oct. 9	3	....	
3	Oct. 6	Oct. 9	3	20	
4	Nov. 7	Nov. 10	3	....	
5	Oct. 8	Oct. 12	4	13.3	Temperature raised for three days only.
6	Nov. 7	Nov. 11	4		
7	Oct. 5	Oct. 10	5	6.6	
8	Oct. 8	Oct. 14	6	13.3	
9	Nov. 4	Nov. 10	6		
10	Nov. 3	... do....	7	26.6	
11	... do....	... do....	7		
12	... do....	... do....	7		
13	Nov. 19	Nov. 26	7		
14	Nov. 19	Nov. 27	8	6.6	
15	Oct. 8	Oct. 21	13	6.6	

Table of experiments undertaken to ascertain the relative virulence of the products of Hog Fever after exposure to the air for different periods of time.

No. of experiments.	Nature of inoculated material.	Date of inoculation.	Date of first signs of illness.	Duration of fever.	Died.	Killed.	Recovered.	Remarks.
1	Inoculated from quill charged with diseased lung fluids of a pig which died five days before in North Carolina.	October 5	October 10	6 days			1	
2	Inoculated from quill charged with pulmonary exudation of a pig that died suddenly in New Jersey, twenty-four hours ago.	October 8	October 14	11 days		1		
3	Inoculated from quill-point dipped in pulmonary exudation of a pig which had been sick for a week or two. Virus from New Jersey, and twenty-four hours from pig.	October 8	October 21	11 days	1			Temperature was abnormally low for two days before death.
4	Inoculated from quill dipped in diseased lung liquids of a pig having no disease of the bowels. Virus from Indiana, and four days from pig.	November 3	November 10	11 days		1		Temperature was abnormally low for two days before death.
5	Pig placed in pen along with diseased intestines (semi-putrid) and manure from diseased pig. Both products from New Jersey, and forty-eight hours from pig.	October 20	No apparent effect					When inoculated this pig had but barely recovered from the slight effects of a former inoculation.
6	Inoculated with the firm fibrous substance from the base of an intestinal ulcer. Also fed a portion of the same. Products from New Jersey, forty-eight hours from the pig, and slightly putrid.	October 20	No apparent effect					
7	Inoculated with the firm fibrous substance from an intestinal ulcer. Product sent from New Jersey, forty-eight hours from the pig and slightly putrid.	October 20	Temperature unaffected.					A pink rash appeared on the skin October 31.
8	Inoculated with portions of dried intestine from North Carolina, and at least four days from the pig. Product dried in sun and air.	November 3	November 10	18 days		1		Rise of temperature very moderate.
9	Inoculated with intestinal ulcer and mucus from Illinois. Product sent in closely corked bottle containing liquid: was at least three days from the pig and slightly putrid.	November 3	November 10	18 days		1		Temperature high throughout.

Table of experiments undertaken to ascertain the relative virulence of the products of ***Hog Fever, &c.*****—Continued.**

No. of experiments.	Nature of inoculated material.	Date of inoculation.	Date of first signs of illness.	Duration of fever.	Died.	Killed.	Recovered.	Remarks.
10	Inoculated with mucus and congested softened mucous membrane from pig No. 14, found dead in its pen the same morning. Product taken not more than twelve hours after death.	November 4	November 10	5 days	......	1	......	
11	Inoculated by injecting under the skin one drachm of blood taken from a diseased pig and kept in an incubator for eleven days, having had communication with the air only through narrow tubes blocked with cotton-wool. The blood smelt stale, but not putrid.	November 19	November 20	20 days	......	......	......	Maintained a high temperature for twenty days with diarrhea, purple ears, purple blotches on body, papules of a pink color and black concretions. After this temperature was normal, but diarrhea and skin eruption and discoloration remained for four days, when it was again inoculated with blood swarming with bacteria (moving).

Experiments undertaken to test the effect of disinfectants on virulent products inoculated.

No. of experiments.	Disinfectant.	Nature and treatment of inoculated material.	Date of inoculation.	Date of first signs of illness.	Duration of fever.	Died.	Killed.	Recovered.	Remarks.
12	Bisulphite of soda	Pig inoculated from a quill dipped in the liquids of a diseased lung in North Carolina, five days ago. Before inoculation the quill was placed five minutes in a solution of bisulphite of soda: 1::500.	Oct. 5	No febrile change.		1			Died the seventh day from lung worms.
13	Carbolic acid	Pig inoculated with quill charged like the last, in North Carolina, six days from the pig, and before inoculation dipped for five minutes in a solution of carbolic acid: 1::500.	Oct. 6	Oct. 9	9 days			1	
14	Sulphate of iron	Pig inoculated with quill charged with virus six days ago, in New Jersey, and before inoculation dipped five minutes in a solution of copperas: 1::500.	Oct. 6	Oct. 9	20 days		1		Killed October 31, after two days of abnormally low temperature, and when already in *articulo mortis*.
15	Chloride of zinc	Pig inoculated from a quill charged with virus from the lungs of a New Jersey hog that had been sick for a week or two; virus one day from the pig. Before inoculation was steeped five minutes in a solution of chloride of zinc: 1::500.	Oct. 8	(?)					High temperature on fourth, sixth, and ninth days only.
16	Sulphurous acid	Pig inoculated with diseased intestine three days removed from the sick hog No. 14, and smoked for five minutes with the fumes of burning sulphur.	Nov. 7	Nov. 11	20 days		1		Killed twenty-sixth day.
17	Chloride of lime	Pig inoculated with diseased intestine, three days from the sick hog No. 14, and steeped five minutes in a solution of chloride of lime: 1::500.	Nov. 7	Nov. 10	11 days		1		Fever ran very high.
18	Bromide of ammonium	Pig inoculated with blood from No. 17, a few drops being added to a drachm of a solution of bromide of ammonium (:1::500) and thrown under the skin.	Nov. 19	Nov. 27	8 days				
19	Permanganate of potassa.	A few drops of blood from No. 17 were mixed with a solution of permanganate of potash and thrown under the skin.	Nov. 19	Nov. 26	18 days	1			Fever ran very high. The day before death the blood contained numerous moving (septic) bacteria.

Experiment No. 20.

Experiment undertaken as a test of the propagation of the disease-poison through the air.

October 5.—A pig was placed in a pen between two infected ones, and separated from each only by an impervious double wall of matched boards, with building-paper between. The only means of communication was through the open air by means of ventilators at the front and back of each pen, and the openings of which in adjacent pens were less than a foot apart. On the ninth, tenth, and eleventh days the pig had an elevated temperature and was lame in the right shoulder, the illness being evidently rheumatic.

On October 29th, the twenty-fourth day, the temperature rose 2° and remained at 104° F. and upward for six days (till November 3rd). It then showed a daily diminution, and by November 8th, having attained the natural standard, the pig was destroyed.

Experiments on sheep, rabbit, and dog. Inoculation with fresh virulent pig's blood, containing moving bacteria.

Subject.	Date of inoculation.	First signs of illness.	Duration of incubation.	Duration of illness.	Remarks.
Merino wether	Dec. 14	Dec. 15	1	......	
Adult female rabbit	Dec. 14	Dec. 15	1	......	
Newfoundland puppy, seven weeks old.	Dec. 14	Dec. 15	1	1	Temperature rose 2.25°, but was normal on the second day.
Female pig, twelve weeks old.	Dec. 14	....	......	......	Purged actively for three days. When inoculated the pig was in advanced non-febrile stage of the fever, and the temperature did not rise above the normal.

Inoculation with fresh virulent blood in which no moving bacteria had been observed.

Subject.	Date of inoculation.	Remarks.
Merino wether	Nov. 21	Scouring and rise of temperature 1° on fourth and sixth days only.
Do	Dec. 7	No appreciable effect.
Adult female rabbit	Nov. 21	Do.
Do	Dec. 7	Temperature rose 1° on the first day only.

Table showing relation of body-temperature to the weather during October.

Date.	Thermometer in open air.				Rain and snow.	Barometer.				Humidity.						Temperature of pigs.					
										7 a. m.		2 p. m.		9 p. m.		Healthy.			Sick.		
	7 a. m.	2 p. m.	9 p. m.	Mean.		7 a. m.	2 p. m.	9 p. m.	Mean.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Rose.	Fell.	Un-ch'nged.	Rose.	Fell.	Un-ch'nged.
Oct. 1	58.0	71.7	62.7	64.13	....	29.336	29.262	29.204	....	58.0	55.5	71.7	63.5	62.7	59.2	......	8	....	......	......	....
2	60.8	67.5	60.1	62.80	....	29.340	29.134	29.126	....	61.8	57.3	67.5	63.0	60.1	58.0	......	8	....	......	......	....
3	50.6	71.2	58.5	60.10	....	29.242	29.144	29.204	....	50.6	49.3	71.2	57.3	58.5	56.0	......	8	....	......	......	....
4	45.6	63.8	57.5	55.63	....	29.252	29.192	29.302	....	45.6	43.5	63.8	52.8	57.5	32.1	7	1	....	......	......	....
5	44.3	55.8	51.6	50.56	....	29.324	29.254	29.248	....	44.3	41.8	55.8	49.5	51.6	50.1	7	1	....	......	......	....
6	50.8	53.8	43.8	49.46	....	29.268	29.318	29.418	....	50.8	47.5	59.8	46.8	43.8	42.1	1	3	....	4	......	....
7	36.6	56.3	51.0	47.96	Three hours' snow, in. 11.	29.418	29.278	29.290	....	36.6	34.1	56.3	47.7	51.0	49.0	2	1	1	2	2	....
8	50.6	62.6	60.9	58.03	....	29.302	29.328	29.140	....	50.6	48.4	62.6	52.5	60.9	59.0	2	2	....	3	1	....
9	62.6	66.3	56.5	61.80	One hour's rain, in. .02.	29.076	28.940	29.156	....	62.6	58.5	66.3	61.5	56.5	55.0	1	......	....	4	2	1
10	48.2	55.0	40.6	47.93	....	29.256	29.352	29.302	....	48.2	45.8	55.0	45.8	40.6	39.2	......	1	....	5	2	....
11	37.4	56.8	51.5	48.56	....	29.250	29.152	29.186	....	37.4	36.5	56.8	49.3	51.5	48.6	......	1	....	3	3	1
12	49.4	55.6	46.5	50.50	Two hours' rain..	29.244	29.226	29.248	....	49.4	46.6	55.6	49.5	46.5	45.7	1	......	....	4	3	....
13	40.3	61.8	52.8	51.63	....	29.334	29.288	29.368	....	40.3	39.0	61.8	51.4	52.8	49.2	......	1	....	1	4	1
14	54.7	71.2	63.2	63.03	....	29.358	29.264	29.272	....	54.7	49.5	71.2	56.8	63.2	61.5	1	......	....	4	2	....
15	60.5	74.2	64.2	61.30	....	29.244	29.186	29.210	....	60.3	53.4	74.2	63.8	67.2	66.0	1	......	....	2	4	....
16	63.0	77.5	67.2	69.23	....	29.288	29.198	29.182	....	63.0	58.0	77.5	62.5	67.2	58.3	......	1	....	1	3	2
17	62.4	75.8	60.4	66.20	Two hours' rain..	29.170	29.020	29.092	....	62.4	58.0	75.8	62.1	60.4	59.0	......	1	....	2	4	....
18	47.5	40.2	40.8	42.83	Two hours' rain, in. 1.2.	29.104	29.082	28.940	....	47.5	45.5	40.2	39.8	40.8	40.2	......	1	....	3	3	....
19	42.5	40.2	43.5	42.06	....	28.872	29.026	29.104	....	42.5	42.0	40.2	38.5	43.5	42.2	1	......	....	1	5	....
20	48.8	55.8	49.0	51.20	....	29.154	29.146	29.210	....	48.8	43.2	55.8	44.8	49.0	46.5	1	......	....	5	1	....
21	41.7	64.5	53.5	53.23	....	29.376	29.306	29.292	....	41.7	39.0	64.5	32.2	53.5	51.0	1	......	....	3	3	....
22	42.0	67.2	54.2	56.80	....	29.880	29.176	29.004	....	49.0	44.8	67.2	54.8	54.2	52.0	......	1	....	3	2	....
23	48.2	49.8	49.8	49.26	Sixteen hours' rain, in. 1.80.	28.880	28.468	28.864	....	48.2	47.5	49.8	49.7	49.8	47.2	1	......	....	4	2	....
24	43.3	51.8	40.2	45.10	....	29.244	29.338	29.456	....	43.3	41.2	51.8	45.3	40.2	39.2	......	1	....	3	3	....
25	33.8	51.3	49.5	44.86	....	29.538	29.456	29.448	....	33.8	32.5	51.3	45.3	49.5	47.7	......	......	1	4	2	....
26	47.8	64.8	61.5	58.03	....	29.452	29.382	29.270	....	47.8	43.3	64.8	55.6	61.5	59.0	......	......	1	1	4	....
27	56.5	49.8	41.8	49.36	Eight hours, in. .47	29.208	29.188	29.202	....	56.5	52.7	44.8	48.0	41.8	41.3	......	......	1	2	2	1
28	37.3	42.5	38.3	39.36	....	29.310	29.328	29.348	....	37.3	33.5	42.5	35.7	38.3	37.0	......	......	1	3	2	....
29	28.6	47.8	41.3	39.23	....	29.394	29.284	29.214	....	28.6	27.8	47.8	39.4	41.3	38.7	......	......	....	2	4	....
30	40.7	49.5	47.2	45.66	Sixteen hours, in. .32.	29.032	28.944	28.910	....	10.7	39.5	49.5	47.2	47.2	45.1	......	......	....	3	3	....
31	41.6	48.6	32.5	39.23	....	28.888	28.866	29.068	....	41.6	38.6	43.6	38.2	32.5	32.1	......	......	....	3	3	....
Mean for month..........				52.67																	

Table showing relation of body-temperature to the weather for November.

Date.	Thermometer in open air.				Rain and snow.	Barometer.				Humidity.						Temperature of pigs.		
										7 a. m.		2 p. m.		9 p. m.				
	7 a. m.	2 p. m.	9 p. m.	Mean.		7 a. m.	2 p. m.	9 p. m.	Mean.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Rose.	Fell.	Unchanged.
Nov. 1	32.8	42.8	39.5	38.36	....	29.210	29.142	29.186	....	32.8	28.0	42.8	36.8	39.5	37.0	2	2	1
2	36.5	52.8	42.0	45.76	....	29.214	29.100	29.260	....	36.5	32.3	52.8	43.0	42.0	39.5	......	......	......
3	34.3	36.6	35.0	55.30	Three hours	29.466	29.456	29.390	....	34.3	31.1	36.6	31.7	35.0	33.5	1	4	......
4	34.2	32.5	29.2	31.96	Four hours	29.322	29.344	29.342	....	34.2	31.3	32.5	27.2	29.2	27.3	1	3	......
5	26.5	33.2	32.5	30.73	Snow	29.438	29.358	29.214	....	26.5	25.8	33.2	28.7	32.5	31.2	2	2	......
6	29.2	35.5	34.2	32.96	Snow 2.5 inches	29.072	28.946	29.050	....	29.2	28.7	35.5	34.2	34.2	32.8	2	3	2
7	31.5	37.2	32.5	33.63	Snow	29.008	28.838	28.866	....	31.5	30.3	37.2	33.4	32.5	31.5	2	......	1
8	25.3	29.2	29.4	28.96	Snow	28.944	29.058	29.110	....	28.3	27.8	29.2	28.5	29.4	27.2	......	6	1
9	29.8	35.2	36.5	33.83	Snow .02 inch	29.160	29.070	29.084	....	29.8	29.4	35.2	31.2	36.5	35.7	2	4	......
10	39.1	42.3	43.7	41.70	....	29.060	29.054	29.020	....	39.1	36.2	42.3	39.7	43.7	40.2	6	......	......
11	40.5	50.0	43.8	45.43	Five hours	28.976	28.732	28.722	....	40.5	39.5	50.0	45.2	45.8	43.8	2	4	......
12	46.4	49.5	44.2	46.70	Three hours .18 inch	29.656	28.750	28.736	....	46.4	45.1	49.5	42.2	44.2	43.0	2	2	2
13	41.0	40.8	34.2	38.33	Four hours .07 inch	28.784	28.998	29.500	....	41.2	34.0	40.8	34.8	34.2	30.8	4	2	......
14	31.4	36.6	28.2	32.06	....	29.436	29.500	29.530	....	31.4	30.6	36.6	32.5	28.2	27.3	1	2	2
15	23.5	40.8	32.5	32.26	....	29.642	29.568	29.544	....	23.5	22.6	40.8	36.2	32.5	31.7	3	3	......
16	36.2	45.5	48.2	42.30	....	29.522	29.464	29.438	....	36.2	34.1	45.5	41.0	45.2	43.2	2	2	1
17	47.5	51.8	48.3	49.20	Rain	29.376	29.278	29.356	....	47.5	46.2	51.8	50.5	48.3	47.8	1	3	1
18	45.8	47.6	46.8	46.73	Rain .26 inch	29.214	29.160	29.170	....	49.8	45.0	47.6	47.5	46.8	46.5	2	1	2
19	45.4	48.3	47.5	47.06	Rain .07 inch	29.136	29.090	29.010	....	45.4	45.4	48.3	46.6	47.5	46.6	1	......	4
20	46.2	48.3	46.7	47.06	....	28.934	28.892	28.920	....	46.2	43.8	48.3	45.8	46.7	46.0	3	4	2
21	43.5	49.8	47.6	47.30	....	29.010	28.972	28.786	....	43.5	43.0	49.8	45.5	47.6	47.0	1	4	3
22	46.8	37.2	36.5	40.16	Rain	28.692	28.364	28.362	....	46.8	43.8	37.2	36.4	36.5	35.8	3	4	......
23	37.8	37.5	35.6	36.96	Rain .93 inch	28.372	28.456	28.670	....	37.8	35.8	37.5	35.0	35.6	34.5	2	5	......
24	39.7	43.6	32.0	38.43	Rain .04 inch	28.920	29.036	29.158	....	39.7	38.2	43.6	40.5	32.0	31.5	1	5	1
25	39.2	43.2	36.3	39.56	....	29.056	28.946	29.170	....	39.2	37.6	43.2	43.5	36.3	35.0	5	1	1
26	32.8	34.5	32.8	33.56	Twelve hours .02 inch	29.328	29.372	29.388	....	32.8	21.8	34.5	30.5	32.8	30.5	7	......	......
27	28.2	35.0	37.2	33.46	Ten hours .46 inch	29.204	28.948	29.004	....	28.2	27.0	35.0	33.6	37.2	56.7	2	3	1
28	42.2	38.2	57.0	39.13	....	28.634	28.856	29.070	....	42.2	39.1	38.2	34.3	37.0	33.8	3	1	2
29	37.6	43.7	59.2	40.16	....	29.208	29.184	29.270	....	37.6	34.2	43.7	36.7	39.2	38.0	1	4	1
30	56.4	38.6	33.6	36.20	....	29.420	29.472	29.466	....	36.4	33.5	38.6	33.3	33.6	32.1	3	1	1
Mean for the month				38.76														

DR. LAW'S SUPPLEMENTAL REPORT.

As an addendum to my former report, I would respectfully submit the following further observations on the fever of swine, commonly known as hog cholera:

EXPERIMENTS IN FEEDING THE VIRULENT MATTER.

A healthy pig was fed the substance of an intestinal ulcer and a little manure from the same bowel, but showed no evil results for fourteen days, when it was put to other uses. It should be added that the ulcer fed to this pig was partially putrid, and was inoculated on two other swine without success.

A second pig was fed a portion of dried intestine and its contents, both of which had remained packed in wheat-bran for a month. Notwithstanding this, the animal retained good health for seventeen days, when it, too, was put to other uses. The material fed to this pig acted with fatal effect on two other pigs on which it was inoculated.

These experiments can only be taken as showing that a small quantity of poison may pass through the intestinal canal with impunity, but they would not warrant the conclusion that similar materials would be equally harmless when taken in larger quantities and with every meal, as invariably happens when swine are fed in the ordinary manner and plunge their filthy feet and noses fresh from the pestiferous manure into the feeding-trough. Dr. Osler has succeeded in developing the disease by feeding the diseased intestine; but as the feeding was accomplished by force there is just the possibility of abrasion and direct inoculation. Abrasions are indeed so common in the mouth from injuries by the teeth and by hard objects masticated and derangements of the epithelial covering of the mucous membrane of the stomach and intestines, are so frequent in connection with slight gastro-intestinal disorders, that it is needless to calculate on an immunity which can only be secured by the entire absence of such lesions. If to secure immunity in feeding we must provide that not even a worm shall bite the mucous membrane of the stomach or intestine, any guarantee rests on an exceedingly slender basis and had best be rejected at once.

SUCCESSFUL INOCULATION WITH FROZEN PRODUCTS OF THE DISEASE.

In two cases I have successfully inoculated virulent products which had been frozen hard for one and two days respectively. In both instances the resulting disease was of a very violent type, and would assuredly have proved fatal if left to run its course. The freezing had certainly failed to impair the virulence; it had rather sealed it up to be opened and given free course on the occurrence of a thaw; for, once it is frozen, it is manifest that no further change could take place until it was again thawed out, and if it was preserved for one night unchanged in its potency, it would be equally unaffected after the lapse of many months, provided its liquids had remained in the same crystalline condition throughout. In this way undoubtedly the virus is often preserved through the winter in pens and yards, as well as in cars and other conveyances, to break forth anew with returning spring. This is precisely what we find to be the case with the other fatal animal plagues, the virus of rinderpest, lung fever, anthrax, and aphthous fever, being often bound up through the winter with frozen manure to reappear with undiminished power on the access of warmer weather. This is a matter of no small moment inasmuch as the long-continued frosts of our Northern States prevent any such destruction of the poison as takes place so readily in summer in connection with the alternate wetting and drying and the resulting putrefaction.

I have had instances brought under my notice in which, after the prevalence of the fever in a herd in early summer, new swine were introduced into the open yard a month or two after all trace of the disease had disappeared and had continued to preserve the most perfect health. This is quite in keeping, too, with my failure in the attempts to convey the disease by feeding and inoculating with a semi-putrid intestine. It serves, moreover, to explain my failure, as the exposure and wet at a moderately high temperature would lead in both cases alike to decomposition and destruction.

The bearing of this upon the prevention of the disease is self-evident. Infected yards and other open and uncovered places may be considered safe after two months' vacation in summer, provided that sufficient rain has fallen in the interval to insure the soaking and putrid decomposition of all organic matter near the surface, and that there are no great accumulations of manure, straw, hay, or other material in which the virus may be preserved dry and infecting. In winter, on the other hand, the yard or other open infected place may prove non-infecting for weeks and months, and yet retain the virus in readiness for a new and deadly career as soon as a thaw sets in. Safety in such circumstances is contingent on a disuse of the premises so long as the frost continues and for at least one month thereafter. Even during the continuance of frost such places are dangerous, as the heat of the animals' bodies or of the rays of

the sun at mid-day may suffice to set the virus free. Again, while they are especially dangerous on the accession of warmer weather, yet, when once the temperature has risen permanently above the freezing point, we may count upon the rapid putrefaction that ensues in all organic bodies that have been frozen and on a disinfection almost as speedy, and it may be at times even more speedy than in the extreme heat of summer. The course of safety is to hold all places that have been infected in late autumn or during winter as still infected until one or two months after the frost has gone out of the ground in spring.

This, of course, has little bearing upon the question of covered pens, barns, cars, &c., in which the poison may be preserved dry, active, and accessible in winter and summer alike. On this question of infection through pens in winter I instituted the following experiment:

CONTAGION FROM AN INFECTED PEN.

A healthy pig was placed in a pen from which a sick one had been removed thirteen days before. The pen had been swept out, but subjected to no disinfection other than the free circulation of air; and as the pig was placed in the pen on December 19, all moist objects had been frozen during the time the apartment had stood empty. The pig died on the fifteenth day without having shown any rise of temperature, but with *post mortem* lesions that showed the operation of the poison. This case was an example of the rapidly fatal action of the disease, the poison having fallen with prostrating effect on vital organs—the lungs and brain—and cut life short before there was time for the full development of all the other lesions. It sufficiently demonstrates the preservation of the poison in covered buildings at a temperature below the freezing point.

SUCCESSFUL INOCULATION OF PIGS WITH VIRUS THAT HAD BEEN KEPT FOR A MONTH IN DRY WHEAT-BRAN.

Appended will be found the daily record of two pigs infected by inoculation with bowel ingesta and mucous membrane that had been preserved for a month in dry wheat-bran. In both cases the disease followed the inoculations promptly and ran a severe course, one case proving fatal, while in the other death was anticipated by killing the animal. At the autopsies the usual characteristic lesions were found.

Here, as in the case of the virus preserved on quill-tips, we find the poison preserved without the slightest impairment of its potency. Thus two series of inoculations with dried virus show how careful and thorough must be the disinfection in dry seasons, and indoors in all seasons, and the importance of the destruction by fire, or in other certain manner, of all dry fodder and litter in which the poison may have been secreted.

COHABITATION WITH SICK PIGS IN DIFFERENT STAGES OF THE DISEASE.

A healthy pig was inclosed in a pen with a sick one which had been inoculated with virulent blood on two occasions; the first thirty days and the last five days before. After the first inoculation the pig had suffered from a slight fever and the characteristic phenomena of the disease. Before the second inoculation the temperature had been normal for eight days, and it was not materially affected by the operation. In short, the disease had manifestly spent itself in the system of the pig, though it had left it a most shrunken, emaciated, and wretched spectacle.

The two pigs occupied the same pen, lay on the same bed, and fed from the same trough for sixteen days, during which no unequivocal sign of disease was manifested in the healthy pig. It seemed indeed to have successfully resisted the contagion.

It was now removed to another pen and placed in company with a pig in which the disease had just reached its height. On the twelfth day thereafter its temperature permanently rose, and it passed through a sharp attack from which it is now recovering.

This seems to show that the poison is much less virulent after the febrile stage of the malady has passed, and that the danger from the recuperating animal decreases with advancing convalescence. At the same time it must not be too hastily concluded that a mild form of the disease did not exist in this pig during the occupancy of the first pen. It appears unquestionable that the poison may be present in the system, and yet give rise to so little disorder that the most careful observer would fail to detect anything amiss.

OCCULT FORMS OF THE DISEASE.

On *post-mortem* sections I have found the characteristic lesions of the bowels and lymphatic glands, in cases where no cutaneous rash or discoloration, no rise of temperature, no loathing of food, nor constitutional disorder had betrayed its presence during life. The occurrence of such slight and occult forms of the disease must present

a serious obstacle to all attempts to stamp it out. In most of the plagues of animals, and notably in lung fever, in aphthous fever, and in rinderpest out of its native home, the rise of the body temperature precedes all outward manifestations of the disease. In these affections the indications of the thermometer alone enable us to separate the sick and healthy before the disease has attained to a stage of material danger to their fellows. But in the pig fever the earliest symptoms will vary according to the vagaries of the poison and its primary seat of election. Perhaps the most common initial symptom is the enlargement of the inguinal glands, but it may be some derangement of the digestive organs, or it may be the elevation of the body temperature, or it may be the appearance of red spots or blotches on the skin, or finally the poison may be operating in the system in the absence of all external manifestations. It is noticeable that since the access of extremely cold weather the cutaneous discoloration has been much less extensive than during the warmer season. Even when the temperature has been abnormally raised it will rise and fall in such an irregular manner that no single observation will be always successful in detecting the disease. To detect such cases the investigation must be conducted from day to day, and in view of all possible manifestations of the disease, to be successful. Then again the temperature, even in health, varies widely in different swine and under different conditions of life, so that a knowledge of the body heat of the individual in the existing environment is essential to the drawing of sound deductions from thermometric indications.

INFECTION OF OTHER ANIMALS THAN SWINE.

I consider the most important part of my researches to be that which demonstrates the susceptibility of other animals than swine to the fever we are investigating. Dr. Kline of London, England, claimed, nearly a year ago, that he had conveyed the disease "with difficulty" to rabbits, Guinea-pigs, and mice, but he gives no hint as to whether he had subjected the question to the crucial test of reinoculation from these animals back upon the pig. This test it seemed very important to apply, so that the identity or otherwise of the two diseases might be determined. I have accordingly instituted experiments on a rabbit, two sheep, a rat, and a puppy, the three former of which have turned out successfully.

INFECTION OF A RABBIT FROM A SICK PIG.

After two inoculatious with questionable results, made with the blood of sick pigs, in which microzymes had been observed, a rabbit was once more inoculated, this time with the pleural effusion of a pig that had died during the previous night, and in which were numerous actively moving bacteria. Next day the rabbit was very feverish and ill, and continued so for twenty-two days, when it was killed and showed lesions in many respects resembling those of the sick pigs. The blood of the sick rabbit contained active microzymes like those of the pig.

SUCCESSFUL INOCULATIONS FROM THE SICK RABBIT.

On the fourth day of sickness the blood of the rabbit containing bacteria was inoculated on a healthy pig, but for fifteen days the pig showed no signs of illness. It was then reinoculated, but this time with the discharge of an open sore which had formed over an engorgement in the groin of a rabbit. Illness set in on the third day and continued for ten days, when the pig was destroyed and found to present the lesions of the fever in a moderate degree.

A second pig, inoculated with the frozen matter which had been taken from the open sore in the rabbit's groin, sickened on the thirteenth day and remained ill for six days, when an imminent death was anticipated by destroying the animal. During life and after death it presented the phenomena of the plague in a very violent form.

It can no longer be doubted, therefore, that the rabbit is itself a victim of this disease, and that the poison can be reproduced and multiplied in the body of this rodent and conveyed back with undiminished virulence to the pig. We may follow Dr. Kline in according a similar sad capacity to the other rodents, mice and Guinea-pigs. The rabbit, and still more the mouse, is a frequent visitant of the hog-pens and yards, where it eats from the same feeding-troughs with the pig, hides under the same litter, and runs constant risk of infection. Once infected they may carry the disease as widely as their wild wanderings may lead them, and communicate it to other herds at a considerable distance. Their weakness and inability to escape, in severe attacks of the disease, will make them an easy prey to the omnivorous hog, and thus sick and dead alike will be devoured by the doomed swine.

PROBABLE SUSCEPTIBILITY OF OTHER RODENTS.

The infection of these rodents creates the strongest presumption that other genera of the same family may also contract the disease, and by virtue of an even closer rela-

tion to the pigs may succeed in conveying the malady to distant herds. The rat is at once suggested to the mind as being almost ubiquitous in piggeries, as feeding in common with the swine, as liable to be devoured by the hog when sick or dead, as given to wandering from place to place, and as possessed of a vicious habit of gnawing the feet and other parts of his porcine companion, and thus unconsciously inoculating him.

I have up to the present time had the opportunity of inoculating but one rat with the hog-poison. Unfortunately my subject died on the second day thereafter, the body showing some suspicious lesions, namely, congested lungs with considerable interlobular exudation, congested small intestines, dried-up contents of the large intestines, and sanguinous discoloration of the tail from the seat of inoculation to the tip.

INOCULATIONS FROM THE RAT.

With the fresh congested small intestine of the rat I inoculated one pig, and with the frozen intestine one day later I inoculated a second. The first had no appreciable rise of temperature, loss of appetite, nor digestive disorder, but on the sixth day pink and violet eruptions, the size of a pin's head and upward, appeared on teats and belly, and on the tenth day there was a manifest enlargement of the inguinal glands. From what I had seen of the occult forms of the disease I was led to the opinion that this was one of them. Unfortunately, I had at the time no healthy pig available for the crucial test of reinoculation.

In the second pig, inoculated with the frozen intestine, the symptoms were too obscure to be of any real value. As soon as I obtain a supply of rats I propose to subject this question to a further investigation.

SUCCESSFUL INOCULATION OF SHEEP.

Less significant than the infection of rats, yet of immense practical importance, is the susceptibility of sheep to the hog-fever. I have experimented on two sheep of different ages, an adult merino wether and a cross-breed lamb, and in both cases have succeeded in transmitting the disease.

INFECTION OF THE MERINO.

This sheep was inoculated by hypodermic injections of one and a half drachms of blood from a pig just killed. On the fourth day he had elevated temperature, and on the sixth scouring and snuffling breathing, but the symptoms rapidly subsided. On the fourteenth day he had an injection of two drachms more of blood from a sick pig, and on the twenty-first day of one drachm of blood and pleural fluid containing multitudes of bacteria. Next day the temperature was raised and the snuffling breathing reappeared, both symptoms continuing for some time. On the sixth day his blood was found to contain moving bacteria similar to those present in the injected blood. On the twenty-third day from the last inoculation he was reinoculated, this time with the scurf from the ear of a sick pig. This was followed by no rise of temperature, but there existed much irritation of the bowels with redness and swelling of the anus, occasional diarrhea, and the passage of an excess of mucus, sometimes stained with blood. Seventeen days after the last inoculation he had another hypodermic injection of one drachm of blood and pleural fluid from a pig just killed. As before, this led to an extensive rise of temperature while the intestinal catarrh continued.

INFECTION OF THE LAMB.

The lamb was first injected with a saline solution of the scurf and cutaneous exudation from the ear of a sick pig. There followed a slight rise of temperature, a scurfy eruption on the ears and oozing of blood from different points on their surface, so as to form dark red scales.

On the sixth day following it was reinoculated by the hypodermic injection of one drachm of pleural fluid from a pig just killed, the fluid containing an abundance of moving bacteria. Next day there was extreme rise of temperature, some dullness and swelling in the right axilla, but appetite and rumination were not altogether lost nor suspended. On the fifth day there was tenderness and unusual contraction of the rectum with the passage of bloody mucus, and on the eighth day profuse diarrhea with the passage of much mucus.

SUCCESSFUL INOCULATION OF A PIG FROM THE SICK SHEEP.

A healthy pig was inoculated with mucus from the anus of the wether, and showed a slight elevation of temperature for five days, but without any other marked symp-

tom of illness. Eleven days later it was reinoculated with scab from the ear of the lamb, and again three days later with anal mucus from the sheep. The day before this last inoculation it was noted that the inguinal glands were much enlarged, and six days after the temperature was elevated, and purple spots appeared on the belly. This fever temperature has lasted but a few days up to the present time, but, taken along with the violent rash and the enlarged lymphatic glands, it furnishes satisfactory evidence of the disease. We can therefore affirm of the sheep as of the rabbit that not only is it subject to this disease, but that it can multiply the poison in its system and transmit it back to the pig.

Two other pigs have been inoculated from the lamb, but during the few days that have elapsed they have shown no outward symptoms.

UNSUCCESSFUL INOCULATION OF A PUPPY.

A drachm of blood and pleural fluid containing bacteria, from a pig just dead, was injected hypodermically on the side of a Newfoundland puppy. Next day she was very dull and careless of food, while her temperature was abnormally high. The third day the heat of the body was natural, and a fair amount of liveliness had returned. A few days later a large abscess appeared on the seat of inoculation, discharged and healed, and from this time the health seemed to be re-established.

SIGNIFICANCE OF THE INFECTION OF RODENTS AND SHEEP.

Many will, no doubt, be startled at the above developments, and inquire, half incredulously, How is it that the susceptibility of these animals to this affection has never been noticed before? It may even be suspected that we have been mistaken as to the identity of the disease, and that we may be dealing with the *malignant anthrax* (*bloody murrain*) rather than the specific fever of swine. But a slight attention to the phenomena and *post-mortem* lesions of our cases will speedily dispel the doubt. *Malignant anthrax* is more fatal to sheep and rabbits than to the other domestic animals, whereas in my sheep the disease was so mild that its very existence would almost certainly have been overlooked in the ordinary management of a flock, and it was only detected in these cases by the careful thermometric and other observations made day by day on the inoculated animals. In the rabbit the disease was more severe, and would undoubtedly have proved fatal if left to itself, yet even in this animal there was no indication of the rapid course and speedy destruction which characterize the *malignant anthrax*. Again, although in both diseases alike, the lymphatic glands are the seat of morbid enlargement, yet the increase and engorgement of the spleen which are so constant and so characteristic in *malignant anthrax* were altogether absent in my pigs infected from the rabbit. Moreover the disease in the pigs ran the usual comparatively slow course of the pig-fever, rather than the speedily fatal one of the *anthrax* affection. In the inoculated pigs, too, the combined lesions of the skin, lungs, bowels, and lymphatic glands are unquestionably those of the swine-plague, and not those of *malignant anthrax*.

It is not surprising that the disease should have been hitherto unrecognized in the sheep and rabbit. The most obvious symptoms in pigs—the pink, purple, violet, or black spots and patches of the skin—were never observed in these animals, unless we can consider the eruption on the ears of the lamb as of this nature. In the sheep, to which alone much attention would be paid, the constitutional disturbance was so slight as to be easily overlooked, the appetite even, and rumination scarcely suffering for a day.

Again, the failure to recognize the identity of a disease in two different genera of animals is familiar to all who have made a study of comparative pathology. Cow-pox and horse-pox have existed in all historic ages, but it remained for the immortal Jenner to recognize and show their identity in the last century. *Malignant anthrax* has prevailed from the time of Moses, yet in all the older veterinary works we find its different forms described as independent diseases—*blain, quarter evil, putrid sore throat,* &c. Even to the present day many cases of this disease occurring in the human subject (malignant pustule) are mistaken for erysipelas (black erysipelas). Glanders in horses seems to have been known to Aristotle, and was familiar to the ancient Greek Zooïatres and Roman Veterinarii, but its identity with the same disease in man was only shown in 1810 by Waldinger, of Vienna. *Asiatic cholera* has prevailed in the East from time immemorial, but it is only in the present century that its identity with cholera in animals has been shown by Indian and European observers.

It is no wonder, therefore, that the mildness of the hog-fever in the sheep should have masked its true nature, and that the universal disregard of the disease of the small rodents should have led us to ignore it in these as well. Now, however, that the truth is forced upon us, we must recognize it in all further attempts to arrest the course of the disease or to exterminate it. The destruction and burial of infected pigs, and the disinfection of the premises where they have been, can no longer be considered a sufficient safeguard. The extermination of rabbits, wild and tame, of Guinea-pigs, of mice, and probably also of rats, within the infected area, will be equally essential. Sheep must be rigidly excluded from the hog inclosures, and if

they have gained admittance they must either be destroyed with the pigs, if few and valueless, or they must be shut up in a secluded place, or sent to a safe distance from all hogs until they can be certified as healthy, when they may be disinfected and released. No danger of a fatal extension among sheep is to be apprehended; the disease appears to be as harmless to the sheep as the fatal glanders is to the dog, yet the infected sheep is evidently dangerous to the hog, and must be carefully secluded in all measures for the suppression of the plague.

RECORD OF DR. LAW'S EXPERIMENTS—NO. 1.

Pig of common race, eight weeks old.

Date.	Hour.	Body temperature.	Remarks.
Nov. 19	10 a. m	104° F.	Costive. Inoculated with blood of pig killed November 8, and kept in inoculator in isolation apparatus, communicating with the air only through plugs of cotton-wool. The blood smells stale, not putrid; its cells have disappeared.
20	....do	104.5	
21	....do	104.5	
22	....do	105.2	
23	....do	104.75	
24	....do	104	
25	....do	104	
26	....do	104.75	
27	....do	104.5	
28	....do	105	
29	....do	104.75	
30	....do	104.75	
Dec. 1	....do	103.5	Quite dull. Purple spots and black concretions on the skin.
2	....do	104.75	Red and black spots on the skin.
3	....do	104.25	
4	....do	102.5	Scours. Ears blue and cold.
4	5 p. m.	104	Do.
5	9.30 a. m	104	Do.
6	....do	105	Do.
7	....do	103.5	
8	....do	103.5	
8	6 p. m	104	
9	9.30 a. m	103	Bowels continue loose.
10	....do	103.5	
10	4.30 p. m	104	
11	9.30 a. m	103	
11	6 p. m.	103	
12	10 a. m	102.25	Feces fluid and of a bright yellow color.
12	5 p. m	102.75	
13	9.30 a. m	102.75	Quiet; ears deep red; extensive papular eruption and greasy exudation on the skin; scouring.
13	5 p. m.	102.5	
14	9 a. m	100.5	Hypodermic injection of one dram of blood and pleural fluid from pig just dead. Inoculation liquid contains numerous actively moving bacteria.
15	....do	102.75	Dull; has not eaten supper of last night.
15	5 p. m.	102.75	Scours.
16	10 a. m	102.25	Do.
16	5 p. m.	102.5	
17	10 a. m	102	
17	4 p. m.	103.25	Slightly costive.
18	10 a. m	101	Sebaceous secretion excessive on the inner sides of thighs and forearms, &c. Has a blackish-brown color, and disagreeable but not putrid odor.
18	4 p. m.	103.2	
19	10 a. m.	103.5	
20	....do	102.5	Improving; regaining appetite and liveliness.
21	....do	103.25	
21	5 p. m.	103	
22	9 a. m	102.5	
22	4.30 p. m	102	
23	9 a. m	103	
24	....do	103.25	
25	....do	103.75	
26	....do	104	
27	....do	102.5	
28	....do	103	
29	....do	104	
30	....do	102	
31	....do	102.75	
Jan. 1	....do	102.5	
2	....do	103	
3	....do	103	
4	....do	102.5	
5	....do	101.5	
6	....do	103	
7	....do	102.75	Killed by bleeding.

Post-mortem examination at once.—Skin: Covered almost universally by a blackish exudation in great part dried into crusts. On the ears are some remnants of the former exudations and extravasations; half an inch of the tip of one ear is necrotic.

Digestive organs: Mouth healthy. *Guttural lymphatic glands* greatly enlarged and gray from pigmentation.

Stomach: Full; contents dry and acid; has reddish discoloration as from blood extravasations and broad lines along its great curvature. The mucous membrane at this point is peeling off.

Small intestine: Contents abundant and liquid. Spots of congestion of about one line in diameter; no ulcers nor erosions; six ascarides.

Large intestine: Presents little abnormal. One or two depressed spots like cicatrices.

Mesenteric glands: Greatly enlarged and mostly grayish from pigmentary deposit. *Inguinal glands* also much enlarged and gray.

Thoracic duct: Is filled with a milky fluid.

Liver: Firm patches of purple. The lower margin very pale; almost transparent.

Spleen: Small, rigid, twisted as if from binding organizing lymph. Its surface is unusually white and fibrous-looking, but there is a deep black line along its anterior border.

Pancreas: Sound.

Heart: Right ventricle marked with bluish discoloration, evidently from former ecchymosis. One flap of the tricuspid valve has a round, blackish nodule beneath the endocardium. Left ventricle with similar bluish surface, and bicuspid valve with a translucent thickening.

Respiratory organs: Larynx and right bronchus have each a dark red ecchymosis. Lungs have black spots of ecchymosis and slight reddening of certain lobules.

Bronchial glands: Enlarged and pigmented.

Subdorsal glands: Enlarged and of a very deep red.

Brain: Generally unchanged.

EXPERIMENT No. 2.

Poland-China pig, nine weeks old.

Date.	Hour.	Temperature of body.	Remarks.
Dec. 19	10 a. m.......	103.5 °F.	Fed infected feces and intestinal mucous membrane preserved for a month in dry bran.
20	....do	104.25	
20	5 p. m........	103.5	
21	10 a. m.......	103.25	
21	5 p. m........	104	
22	9 a. m........	103.5	
22	4.30 p. m....	102.5	
23	9 a. m........	102.75	
24	....do	102	
25	....do	101.75	
26	....do	103.5	
27	....do	102	
28	....do	100.75	
29	....do	102	
30	....do	101	
31	....do	101	
Jan. 1	....do	102.5	
2	....do	102	
3	....do	103	
4	....do	102.75	
5	....do	103	Inoculated with intestine of pig which died yesterday. The intestine had been frozen over night.
6	....do	103	
7	....do	104.75	
8	....do	105	
9	....do	104	
10	....do	103	
11	....do	105	
12	....do	104	
13	....do	105.25	Purple spots on ears and rump; greasy exudation from skin. Enlarged inguinal glands.
14	....do	105	
15	....do	106.5	Scours; a bright-yellow liquid feces.
16	....do	105	Do.
17	....do	105	Do.
18	....do	105.5	Scours.
19	....do	105.5	Do.
20	....do	105.5	Do.
21	....do	103	Do.
22	....do	107	Great prostration; will not rise for food nor to have temperature taken. Purple blotches are especially abundant on ears and snout, and to a less extent on the head, generally the teats, rump, and hips. When lifted scarcely made a struggle. Killed by bleeding.

Post-mortem examination.—Blood: Dark colored; contained moving bacteria.

Digestive organs: Tongue sound. Tonsils unusually red in their openings.

Submaxillary and guttural lymphatic glands: Of a dark red, merging to a dirty yellow.

Peritoneum: With considerable reddish-brown effusion and bands of recently formed false membrane. The liquid coagulates on exposure. Under the microscope (No. 10 Hartnack) it is seen to contain numerous moving bacteria, also others less active, and two or four segmented chain-like.

Stomach: Full; sour. Great curvature mottled red and brown.

Small intestines: Has considerable tracks of deep congestion. It contains much mucus, and ten ascarides. One ascaris extended into the gall-duct and as far as the center of the right lobe of the liver; a second extended into the middle hepatic lobe. The pressure of these had led to a considerable dilatation of the bile-duct just above its junction with the cystic duct.

Ilio-cæcal valve: Very black, with its follicles enlarged and filled with a yellowish product. The whole length of the large intestine is black from deep pigmentation of its mucous membrane, which is, besides, greatly thickened and puckered. Both conditions imply former active inflammation.

The rectum: Of a dark grayish red; had several caseous deposits under its mucous membrane.

The mesentery: Contains a yellowish caseous deposit as large as a pea.

All the *lymphatic glands of the abdomen* are greatly enlarged, pigmented, and in many cases reddened from recent blood-staining. The *inguinal lymphatic glands* and those of the flank are in a similar condition.

Liver: Has patches of deeper purple discoloration, especially deep in the center of the acini. *Pancreas* sound.

Spleen: Shrunken with puckered edges, and whitish thickening of its proper capsule.

Kidneys: Vascular, congested and softened; corticle part dull brownish yellow. Medullary, more or less purple, with deeper shades in lines radiating from the papillæ.

Respiratory organs: Margin of epiglottis bears a blue patch, surrounded by ramified redness. *Bronchi* and bronchia sound.

Lungs: Of varying shades of light pink in the lobules, excepting one or two, which are of a dark red. The interlobular spaces are of a deep blood-red color, giving a dark marbling over the entire surface. *Right pleura* contains a little effusion with thread-like false membranes, and the same bacteria named as existing in the peritoneum.

The *axillary prepectoral, internal pectoral, bronchial,* and *sub-dorsal lymphatic glands* were enlarged, pigmented, and in some cases blood-stained.

The *heart* bore some purple discolored spots on the internal lining.

EXPERIMENT No. 3.

Poland China pig, nine weeks old.

Date.	Hour.	Temperature of body.	Remarks.
Dec. 19	10 a. m.	102.5 °F.	Placed in infected pen from which a sick pig had been removed December 6.
20	....do	102.75	
21	....do	103.75	
21	3 p. m.	103	
22	9 a. m.	102.8	
22	4.30 p. m	102	
23	9 a. m.	101	
24	....do	102.75	
25	....do	101.5	
26	....do	102	
27	....do	102.75	
28	....do	101.75	
29	....do	98.8	
30	....do	101	
31	....do	101.5	
Jan. 1	....do	100	
2	....do	101	
3	....do	101	
4	....do	96.5	Eyes very red and prominent. Scarcely able to stand. Screams when touched. (Evident phrenitis.) Died at 2. p. m.

Post-mortem examination the same afternoon.—Skin: Presented little change.

Digestive organs: Mouth sound, fauces and pharynx of a deep blue color, irremovable by pressure.

Stomach: A portion of about an inch square of a deep red, and with an abundant gelatiniform exudation under the mucous membrane.

Small intestines: Empty, much congested, and containing ten ascarides.

Large intestines: Has its mucous membranes congested, reddened, and thickened. At intervals are circumcscribed spots of bloody extravasation, covered by a clot of blood on the free surface. These vary from one to two lines in diameter. In a great portion of the colon the contents are very dry and blood-stained. Between the layers of the mesentery, among the convolutions of the large intestines, are translucent gelatinoid exudations.

Liver: Gorged with blood, softened, and somewhat friable.

Spleen and *pancreas:* Normal.

Mesenteric glands: Small, but in some instances partially discolored by blood.

Lungs: Congested throughout, of a brick-red, with circumscribed black spots of extravasation.

Bronchia: Filled with frothy liquid, but without worms.

Heart: The right cavities were gorged with an intensely black clot. The left cavities contained a smaller clot. No ecchymosis was observed.

EXPERIMENT No. 4.

Poland China pig, nine weeks old.

Date.		Hour.	Temperature of body.	Remarks.
Dec.	19	10 a. m	103.75° F.	Inoculated with virus preserved one month in wheat bran.
	20	....do	104.2	
	20	5 p. m	104.5	
	21	10 a. m	104	
	21	5 p. m	105	
	22	9 a. m	104	
	22	4.30 p. m	104.75	
	23	9 a. m	103.5	
	24	....do	104	
	25	....do	102.25	
	26	....do	101.75	
	27	....do	103.75	Passes bloody mucus from the bowels.
	28	....do	102.75	
	29	....do	102	
	30	....do	101	
	31	....do	105	
Jan.	1	....do	106	
	2	....do	103	
	3	....do	102	
	4	....do	101	
	5	....do	101	
	6	....do	98.75	Very low; can scarcely stand. Died during the following night.

Post-mortem examination January 7.—*Skin:* Extensively covered with purple maculæ and patches. Snout deeply blood-stained, some of the spots extending over the lips into the mouth. The greater part of the skin being black, congestions and extravasations into it are only clearly made out when it is cut into.

Digestive organs: Tongue sound. Pharynx has pellets of food accumulated in front of the epiglottis. Submaxillary and guttural lymphatic glands enlarged and stained of a blood red.

Stomach: Not one-third filled; odor faint, mawkish, not sour. Bears red patches of congestion and ecchymosis on its great curvature.

Small intestines: Congested almost throughout. Peyer's patch just above the ilio-cæcal valve has some black ecchymosis. On the lower surface of the valve the follicles are enlarged and filled with a yellowish deposit.

Cæcum and, to a still greater extent the *colon* and rectum, are deeply congested, and of a dark red; the mucous membrane is much thickened and thrown into prominent folds and wrinkles.

Two ascarides were found in the small intestine.

Liver: Extensively discolored of a purple hue, the staining being deepest in the center of the acini.

Spleen: Large, gorged with blood. *Pancreas* unchanged.

The lymphatic glands of the liver, stomach, intestines, sublumbar region, pelvis, groin, and flank are much enlarged and of a very deep red, in many cases almost black.

Kindeys: Cortical substance pale; medullary deep red, with spots of ecchymosis. The anterior part of the left kidney contained a cyst as large as a bean. The right contained two cysts, one in the pelvis, the other in the anterior part.

Respiratory organs: The *epiglottis* bore on its posterior surface some congestion and redness, partly ramified and partly diffuse and ineffaceable by pressure.

The lungs have a few black spots of ecchymosis and blood-colored extravasation in the connective tissue between the lobules. The lobules themselves are only very slightly congested. The left main bronchus present a spot of ecchymosis.

Heart: Empty, presents slight sanguineous discoloration through the lining membrane.

EXPERIMENT No. 5.

Poland China pig, nine weeks old.

Date.	Hour.	Temperature of body.	Remarks.
Dec. 19	10 a. m....	104° F	Inoculated with ingesta from the large intestine; also a portion of the mucous membrane, both having been preserved in dry bran for a month.
20	....do	104. 5	
21	....do	103. 75	
21	5 p. m.....	104	
22	9 a. m	103	
22	4. 30 p. m..	104	
23	9 a. m	101	
24	....do	103. 5	
25	....do	103	
26	....do	102. 5	
27	....do	102. 5	
28	....do	102. 75	
29	....do	101	
30	....do	102	
31	....do	105	
Jan. 1	....do	106. 75	Rump and tips of ears purple.
2	....do	104. 75	
3	....do	102	Scours.
4	....do	102	
5	....do	102	
6	....do	103	
7	....do	101. 25	
8	....do	102. 5	Scours; feces fetid.
9	....do	101	Very weak; eats little; fetid diarrhea.
10	....do	100. 9	
11	....do	100	
12	....do	98. 5	
13	....do	102. 5	
14	....do	100. 5	
15	....do	104. 5	Killed by bleeding.

Post-mortem examination at once.—Skin: Ears of a deep purple and thickly covered with concretions. Remainder of the skin has similar concretions, but no ecchymosis is observable. The snout presents scarcely a spot of discoloration.

Digestive organs: Extensive induration and ulcer on the left side of its median part and extending over its border. A similar but smaller ulcer exists on the right margin directly opposite. Small ulcers exist on the dorsum near the hip; also a diphtheritic-looking deposit extending over the margin on to the lower surface. Tonsils, palate, and pharynx sound. Submaxillary and gutteral lymphatic glands are enlarged and congested.

Stomach: Has its mucous membrane thick, rugose, and as if water-soaked along its great curvature.

Small intestine: With mucous membrane thickened and puckered throughout; the duodenum deeply congested.

Ilio-cæcal valve: Thickened; its follicles enlarged and filled with a yellowish deposit. Mucous membrane of *cæcum* and *colon* deeply pigmented and of a dark gray aspect. Some parts of the colon are still red in patches. Rectum pigmented, presents several small ulcers and a caseous deposit beneath the mucous membrane.

Liver: Bears blue patches of various sizes; gall-bladder contains a little bile of a bright yellow color, with greenish flakes.

Spleen: Small and puckered, so that its borders turn inward.

Pancreas sound.

Abdominal lymphatic glands: Hepatic, gastric, splenic, pancreatic, mesenteric, sublumbar, and pelvic, as well as the iliac, are enlarged, pigmented, and partially congested.

Kidneys: Corticle substances pale yellowish, slightly softened; in the case of one, reddened to the depth of one-third line. Medullary portion deeply colored.

Respiratory organs: Larynx and trachea sound; right lung with almost the normal pale pink hue externally, but seems to be congested internally when cut into; left lung nearly normal; *heart* and pericardium normal.

EXPERIMENT NO. 6.

Poland China pig, eight weeks old.

Date.	Hour.	Body temperature.	Remarks.
Dec. 19	10 a. m....	104° F.	Placed in pen with pig partially convalescent.
20	....do	103	
21	....do	103.75	
21	5 p. m.....	104.5	
22	9 a. m.....	103.75	
22	4.30 p. m..	104	
23	9 a. m.....	104.25	
24	....do	102.75	
25	....do	103.75	
26	....do	105	
27	....do	103	
28	....do	104	
29	....do	104	
30	....do	103	
31	....do	102.5	
Jan. 1	....do	102	
2	....do	103	
3	....do	103.25	
4	....do	103	Placed in pen with another pig in height of the disease.
5	....do	103	
6	....do	101	
7	....do	102.75	
8	....do	102.5	
9	....do	103	
10	....do	103	
11	....do	103.25	
12	....do	104	
13	....do	101.25	
14	....do	103.5	
15	....do	106	
16	....do	105	
17	....do	105.5	Feces coated with film of blood
18	....do	104.8	
19	....do	104.5	Bloody feces.
20	....do	104.25	Do.
21	....do	105	Do.
22	....do	103	Do.
23	....do	103	Do.
24	....do	103	Bloody feces. Inguinal lymphatic glands enlarged.
25	....do	101	
26	....do	104.75	
27	....do	104	
28	....do	103	Appetite improving.
29	....do	102	
30	....do	102	
31	....do	103	

EXPERIMENT NO. 7.

Female rabbit.

Date.	Hour.	Body temperature.	Remarks.
Nov. 21	....	....	Inoculated hypodermically with one drachm of the blood of sick pig just killed.
22	9 a. m	104° F.	
23	....do	104	
24	....do	104.1	
25	....do	104.5	
26	....do	104.5	
27	....do	104	
28	....do	104.5	
29	....do	104	
30	....do	104	
Dec. 1	....do	104	
2	....do	104	
3	....do	104	
5	....do	104	
7	....	....	Hypodermic injection of one drachm of blood of pig which died during last night.
8	9 a. m	105	
9	....do	104.75	
10	....do	103.75	
11	....do	103.75	A firm ovoid nodule in the seat of inoculation.
12	....do	104.5	
13	....do	103	

EXPERIMENT No. 7—Continued.

Date.	Hour.	Body temperature.	Remarks.
Dec. 14	9 a. m.	103. 5° F.	Hypodermic injection of one drachm of blood of pig found dead this morning. Blood swarming with actively-moving bacteria.
15	....do	105. 5	Has not eaten supper.
15	5 p. m.	105. 5	Eats nothing.
16	10 a. m	106. 25	
16	5 p. m.	106. 75	
17	10 a. m	105. 5	
17	4 p. m.	103	
18	10 a. m	105. 75	
18	4 p. m.	105. 5	
19	10 a. m	104	Blood showed numerous moving bacteria as in the pig. Induration in the right iliac region.
20	....do	104. 75	
21	....do	103. 5	
21	5 p. m.	104. 5	
22	9 a. m	103. 5	
22	4.30 p. m	104. 25	
23	9 a. m	103. 5	
24	....do	104	
25	....do	104	
26	....do	104. 75	
27	....do	104. 75	
28	....do	105	Abscess has burst to the right of vulva. A white fibrous extravascular mass exposed.
29	....do	104	
30	....do	105	
31	....do	105	
Jan. 1	....do	104	
2	....do	104	
3	....do	103	
4	....do	103	
5	....do	103	
6	....do	102. 5	Is very low and has eaten little for some days.
7	....do	102	Sore still open. Killed by bleeding.

Post-mortem examination at once.—Connected with the raw sore in the groin was an immense mass of whitish, fibrous material, infiltrated with pus, and extending from the lumbar vertebræ above to the median line below. The mesenteric glands were enlarged and blood-stained. Two had been transformed with yellow, cheesy-looking masses. The stomach and bowels appeared healthy; also the liver and spleen, heart and lungs.

EXPERIMENT No. 8.

Poland China pig, eight weeks old.

Date.	Hour.	Body temperature.	Remarks.
Dec. 18	4 p. m.	102. 75° F.	Inoculated with blood of sick rabbit hypodermically.
19			
20			
21	4 p. m.	103. 5	
22	9 a. m.	101. 5	
22	4.30 p. m	103. 75	
23	9 a. m.	100. 75	
24	....do	101	
25	....do	101	Skin hot. Hides under the litter.
26	....do	101. 5	
27	....do	101	
28	....do	101	Scours.
29	....do	100	
30	....do	100	
31	....do	102	
Jan. 1	....do	102. 75	
2	....do	102	Inoculated with matter from open sore of sick rabbit.
3	....do	101. 5	
4	....do	102	
5	....do	103. 5	Feces fetid.
6	....do	104. 5	
7	....do	104. 75	
8	....do	104. 5	
9	....do	104. 25	Fetid diarrhœa.
10	....do	103	
11	....do	103	
12	....do	102. 5	
13	....do	103	
14	....do	104. 75	
15	....do	105	Killed by bleeding.

Post-mortem examination.—Skin: Naturally black; no purple nor congested spots seen.

Digestive organs: Mouth and throat healthy.

Guttural lymphatic glands: Enlarged and somewhat congested.

Stomach: Moderately full; of a deep brownish red along its great curvature.

Small intestine: Slightly congested in patches; contains twelve ascarides.

Large intestine: Nearly normal.

Mesenteric lymphatic glands: Enlarged and slightly congested. Their surface presents clear, glistening, rounded masses like pins' heads. *Inguinal glands* have the same character.

Lung: Isolated lobulettes are dark red and solid; at some points the interlobular connective tissue is distended by a dark-red infiltration.

In the bronchia of the left lung were twelve strongyli.

Experiment No. 9.

Common white pig, ten weeks old.

Date.	Hour.	Body temperature.	Remarks.
Jan. 7	10 a. m.	104° F.	Inoculated with frozen white product from the groin of the infected rabbit.
8	....do	102.5	
9	....do	103	
10	....do	103	
11	....do	101.75	
12	....do	102	
13	....do	103	
14	....do	103	
15	2 p. m.	101	
16	10 a. m.	102.25	
17	....do	103.25	
18	....do	103.8	
19	....do	103	
20	....do	105.25	
21	....do	105.3	
22	....do	104.5	Purple spots on rump. Eats little.
23	....do	105	Blue ears.
24	....do	102.5	Scours, bright-yellow liquid feces. Inappetence.
25	....do	105	Do.
26	....do	98.75	Do.
27	....do	97	Does not rise when temperature is taken; is stretched on its side with muscular jerking. Killed by bleeding.

Post-mortem examination.—Skin: Margin of snout for one-half line deep of a dark brown, and apparently without vascularity or life. Beneath this is a red congested line.

Ears: Deeply blotched with dark red and purple maculæ, each about one-half inch in diameter, but to a great extent confluent, so as to form extended lines and patches. Stump of tail maculated. Perineum and adjacent parts of hip of a deep purple.

Digestive organs: Tongue with a whitish fur. On the center of its dorsal surface is a dark spot about two lines in diameter, which is found to cover a considerable extravasation and clot on the muscular substance. Glandular follicles on the lower surface of the soft palate filled with a soft yellowish puriform mass.

Submaxilliary lymphntic glands: Greatly enlarged and of a deep purple. *Guttural glands* also blood-stained and moderately enlarged.

Stomach: Full, very fetid, not sour. Great curvature has its mucous membrane much congested with numerous black spots of extravasation projecting beyond the general surface. In the left *cul de sac* the ingesta next the mucous membrane is of a dark baked appearance and firmly adherent to the mucous membrane, the epithelial layer of which comes off with it. It has evidently been adherent for some time.

Small intestines: Have large tracts of congestion, and in the duodenum and commencement of the jejunum are ten ascarides. Seven ascarides have made their way into the gall duct and the different lobes of the liver, but none in the cystic duct nor gall-bladder. The biliary duct is greatly distended and coated with a layer of yellowish-green biliary coloring matter.

The ilio-cœcal valve: Has its margin of a deep grayish-black and its follicles enlarged.

The large intestines: Are throughout black from pigmentary deposit, the blackness being especially marked on the agminated gland, extending from the ilio-cæcal valve on the colon. Many round blackish elevations are scattered over the length of the colon, appearing like enlarged solitary glands. On some parts of the colon the dark

color is modified by the deep red of a recent congestion. Through the whole length of the large intestine the mucous membrane is considerably thickened and puckered. Near the anus are some caseous deposits beneath the mucous membrane, but communicating with the surface by open orifices.

The liver: Has great patches of a deep purple, deepest in the center of the ascini.

The gall bladder: Is full of dark dreen, thick, very viscid bile.

The inguinal, sublumbar, mesenteric, mesocolic, gastric, and hepatic lymphatic glands: Are greatly enlarged and deeply blood-stained.

The kidneys: Somewhat softened, are of a dull yellowish brown in the cortical portion and of a purple hue, with darker radiating lines in the medullary.

Respiratory organs: Larynx sound. Lungs sound, excepting some slight congestion in particular lobes, and the filling of the bronchia and air-cells with blood evidently drawn in in dying. No pleural effusion.

Heart and pericardium: Sound.

EXPERIMENT No. 10.

Merino sheep.

Date.	Hour.	Body-temperature.	Remarks.
Nov. 21	2 p. m.	103° F.	Hypodermic injection of one and a half drachms. Blood from sick pig just killed.
22	10 a. m.	102.5	
23	....do	103.75	
24	....do	103	
25	....do	104.5	
26	....do	103.25	
27	....do	104.5	Scouring and snuffling.
28	....do	103.75	
29	....do	102	
30	....do	102.5	
Dec. 1	....do	103.75	
2	....do	102.5	
3	....do	103.25	
5	....do	102.5	
7	....	....	Hypodermic injection of two drachms blood from pig which died during the night previous.
8	....do	103.75	
9	....do	103.3	
10	....do	103.75	
11	....do	100.25	
12	....do	102	
13	....do	103	
14	....do	103	Hypodermic injection of one drachm blood and pleural fluid of pig which died during the preceding night. Fluids full of actively moving bacteria.
15	....do	105.5	Snuffling.
15	5 p. m.	105	
16	10 a. m.	104.5	
16	5 p. m.	104.5	
17	10 a. m	105.5	
17	4 p. m.	103.5	
18	10 a. m	103.75	
18	4 p. m.	105	
19	10 a. m	103.25	
20	....do	105.2	Blood shows moving bacteria, but less numerous than in the rabbit.
20			
21	10 a. m	102.25	
21	4 p. m.	104	
22	9 a. m	104	
22	4.30 p. m	105.25	
23	9 a. m	103.25	
24	....do	102	
25	....do	103	
26	....do	104	
27	....do	103.75	
28	....do	103.2	
29	....do	103.5	
30	....do	102.75	
31	....do	104	
Jan. 1	....do	103	
2	....do	103.75	
3	....do	103	
4	....do	102	
5	....do	103	
6	....do	103	Inoculated with scurf from the ear of a sick pig
7	....do	102	
8	....do	102.75	Scours.
9	....do	103.8	Do.

EXPERIMENT NO. 10—Continued.

Merino sheep—Continued.

Date.	Hour.	Body-temperature.	Remarks.
Jan. 10	....do	103° F.	Scours. Anus red and sore. Strongly objects to the thermometer. Has passed bloody mucus.
11	....do	103	
12	....do	102	
13	....do	102.5	
14	....do	103.5	Anus still red and puffy, with abundant mucus.
15	....do	103	
16	....do	103.5	
17	....do	103.5	Scours.
18	....do	103	Do.
19	....do	104	
20	....do	102.75	
21	....do	103	
22	....do	102.5	Anus still red and swollen.
23	10 a.m	102	Same afternoon injected one drachm of blood and pleural fluid from pig just killed. Fluids contained active bacteria.
24	....do	104	Slight subcutaneous swelling in the right axilla. Tenderness of the skin of the abdomen.
25	....do	104.5	
26	....do	104	
26	4.30 p.m	105	
27	12 m	105	
28	10 a.m	103	
28	5 p.m......	104	
29	10 a.m	105	
30	....do	104	

EXPERIMENT NO. 11.

Long wooled (cross-breed) lamb.

Date.	Hour.	Body-temperature.	Remarks.
Jan. 17	10 a.m	104.25° F.	Injected hypodermically in the axilla matter from the ears of two sick pigs, also anal mucus from one of them.
18	....do	104.25	
19	....do	103.8	
20	....do	105.25	
21	....do	103.5	Ears with scurfy eruption.
22	....do	106.5	Bleeding spots on ears.
22	5 p.m.......	104.75	
23	10 a.m	104.5	Injected hypodermically one drachm pleural fluid containing actively moving bacteria from pig just killed.
24	....do	108	Hard engorgement two inches in diameter in right axilla.
25	....do	107	Axillary swelling more defined; like a hazel-nut.
26	....do	104	
26	4.30 p.m	108	
27	12 m	108	
28	10 a.m	105.25	Rectum contracted and tender; thermometer covered with bloody mucus.
28	5 p.m	106	
29	10 a.m	106	
30	....do	104	

JAMES LAW.

ITHACA, N. Y., *February* 5, 1879.

REPORT OF DR. D. W. VOYLES.

HON. WM. G. LE DUC,
Commissioner of Agriculture:

SIR: In conducting an examination of the diseases of swine, as prevailing throughout the State of Indiana during the present season, the following plan was pursued, viz:

A tour of observation and inspection was made through the counties of Floyd, Harrison, Washington, Greene, Morgan, Monroe, Owen, Put-

nam, and Bartholomew. Some of the most intelligent and leading stock men of each county were sought, and all the information obtained which they had upon the subject of the disease, both in regard to its present manifestation and past history. Speculators in live hogs and large feeders were closely interrogated upon every feature of the disease as coming within the range of their experience and observation. Diseased herds were visited, and in each case the farm minutely inspected in all its bearings upon the health of animals; the methods of breeding, feeding, and general management of swine diligently inquired into; dead animals, where not too far advanced in decomposition, dissected, and living ones, having the disease, were slaughtered for examination, and the pathological indications carefully noted. The month of September was entirely devoted to this branch of the investigation.

The object of this method of inquiry was to ascertain whether the disease, as prevailing throughout these several districts, was uniform in its character, differing only in such modification in type as may be due to local influences; or whether these were to be found separate and distinct diseases in different localities, due to entirely different causes for their production; and if uniformity was found to exist in the character of the disease as now prevailing, to learn from practical and intelligent observers in each district whether, in any essential particular, it differs from the disease that has prevailed in other years.

PREVALENCE OF THE DISEASE.

The several districts visited were all more or less affected by the disease, but to a much less extent than during former years, except, perhaps, in the county of Putnam, where it was prevailing for the first time as a general and wide-spread epidemic, the loss being estimated at from fifty to sixty thousand dollars. In this county the surface is sufficiently undulating to produce good drainage; the soil is red clay on limestone. Springs of pure limestone water are abundant, and woodlawns beautifully swarded with blue grass are seen upon almost every farm. Feeding swine has been an extensive and profitable branch of farm industry in this county, and the herds are, therefore, quite large for a grass-growing section. During the summer months hogs in this county run upon blue grass and clover, and are fed some corn. We found the corn so fed often unfit for use, because of a very reprehensible practice of hauling to the field for convenience in feeding and throwing it in an open rail pen, where, by exposure to heat and moisture, it soon becomes moldy. The mean temperature in this county during the summer was slightly above, and the rain-fall considerably below, the average seasons.

The counties of Floyd, Harrison, and Washington possess much the same kind of soil, and are abundantly supplied with running springs of limestone water; but blue grass and clover are not so extensively or generally grown. In these three counties hog-raising is not a branch of farm industry sufficiently remunerative to induce the farmers to generally engage in it, and the herds are, therefore, usually small and the animals very imperfectly cared for.

The observations made in the counties of Greene, Owen, Monroe, Morgan, and Bartholomew were on a line with the White River Valley. This and the Wabash Valley constitute pre-eminently the hog-growing sections of Indiana. It is in this part of the State that the disease has prevailed to the greatest extent. Hog-raising being the leading business industry, the herds are ordinarily quite large.

No observations were made in the Wabash country. In the White

River Valley the disease has prevailed during the present season to much less extent than for several years past. This is due in part to the fact that there are not so many hogs here as formerly—great loss having greatly discouraged hog-raising, a branch of agricultural industry heretofore paramount to every other interest.

The less prevalence of the disease is also due in part to the increased facilities for selling to summer packers; the approach of the complaint in any given locality being the signal for the selling of every marketable animal.

In these hog-growing districts, the surface of the country is quite flat, affording very imperfect natural drainage, and as a consequence much stagnant water prevails. The soil is a mixture of clay and sand. The food is mainly corn, with some clover during the summer months, the animals often subsisting upon corn alone from the time of birth to that of slaughter.

In the county of Bartholomew there are several "grease factories," where they render dead animals, and it is estimated that during the year 1876 there were rendered at these several factories no less than one hundred thousand animals that died of the disease in that and adjacent counties.

It is the concurrent testimony of the leading and most intelligent observers, whose experience and observation have been most extensive, that while the disorder prevails more or less at all seasons of the year, it prevails to the greatest extent and with most fatal effect during the dry months of the fall season, and again during the last winter and first months of spring—February and March.

SYMPTOMS OF THE DISEASE.

A greater degree of uniformity was found to exist in the symptoms and character of the disease than was anticipated at the beginning of the investigation. The first symptoms that usually attract the attention of the farmer, indicating approaching disease, is a wheezing cough, coupled with a disposition to mope. During this period the animal stands about as if in a "brown study," with its ears dropped and its eyes inclined to water or matter.

Following in the usual succession of symptoms comes a failure in the appetite, with occasional vomiting and diarrhea, although the two last-named symptoms constitute an exception, to which constipation is the rule.

A complete failure in the appetite, intense thirst, with increased temperature of the body, indicates the supervention of the febrile and inflammatory stage of the disease. During this stage the temperature not infrequently rises as high as 107° F., as indicated by the introduction of the thermometer into the rectum of the animal. The cough increases; the breathing becomes more accelerated and laborious; the respiratory movements are scarcely observable in the walls of the chest, but become conspicuous at the flank, and range from 30 to 60 inspirations to the minute; the arterial circulation is increased in frequency and diminished in volume. Petechial eruption is often observed on the skin and is most distinctly observable on white animals. This is due to extravasated blood from the capillaries into the tissues, which, on undergoing decomposition, produces ulceration of the skin in the future course of the disease, particularly if the animal becomes convalescent.

In the last stage the animal becomes very weak; staggers in gait, if able to rise at all; refuses both food and drink; falls in temperature

sometimes as low as 60° F.; seeks the sunshine or a covering of litter, and speedily dies. Emaciation is a rapidly progressive symptom throughout the entire course of the disease.

DURATION OF THE DISEASE.

The disorder is by no means uniform in its duration, varying from a few hours to many days and even weeks. When death occurs only a few hours after the attack a complication of heart disease is usually the cause of the rapid termination of the case. Early fatality may occur also from rapid congestion of the lungs, producing hepatization of a large portion of that organ. The average duration of the disease can be, therefore, scarcely approximated. Perhaps five days would include the length of time consumed in most fatal cases, whereas a much greater length of time is required in cases that recover. In its most violent epidemic form a much less time than five days would include the course of the disease in all fatal cases.

PATHOLOGY OF THE DISEASE.

As before stated, all dead animals not too far advanced in decomposition were examined, and one or more sick animals were selected from each diseased herd, and after a careful study of their symptoms, as compared with the other sick stock of the herd, were slaughtered for examination.

Memoranda from thirty dissections made from fifteen separate and distinct herds fairly representing the disease as observed under all the varied circumstances as to food, soil, water, and general management, show the following results:

In every case, without exception, disease of the lungs was present, varying in degree from slight congestion to complete softening from suppuration and inflammation. In two cases the lung disease was tuberculous in character. In eight cases adhesion occurred between the costal pleura and lung. In six cases circumscribed spots of inflammation were found on the walls of the heart and its investment, with an effusion in the pericardial sack. In six cases were small patches of ulceration of mucous lining of large intestine. In six cases were congestion of mucous lining of the stomach. In all cases the liver presented a darker hue than natural, in four cases slightly, and in one greatly enlarged; but in all other cases in size and general appearance would compare favorably with that organ as usually observed in animals regarded sound and healthy. The spleen was in all cases discolored, as in case of the liver. In few cases there was slight congestion of the kidneys. In one case there was evidence of fatty degeneration, and in all others the organ indicated a healthy condition. The blood was always dark-colored, the muscles pale and relaxed.

The disease of the lungs was in all cases the leading pathological condition, to which all other diseased appearances were secondary in importance, constituting complications only.

A section of the lung of an animal slaughtered during the active inflammatory state of the disease shows, under the microscope, a complete solidification of lung-tissue, the air-cells being filled with epithelial exudation, no extravasated blood appearing. A section of the liver of the same animal shows a thickening of the septæ acini by a proliferation of epithetial cells, tending to or constituting fatty degeneration; other acini in the same section exhibit a perfectly healthy condition. A sec-

SWINE FEVER.

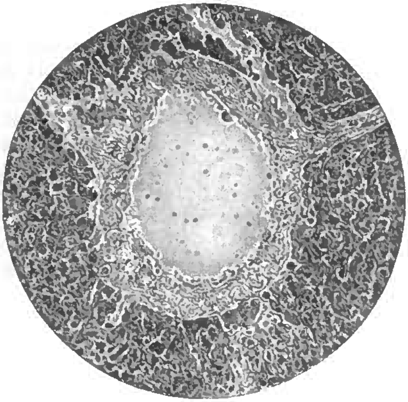


Fig. 1.
Microscopic section of diseased liver in "Hog Cholera."

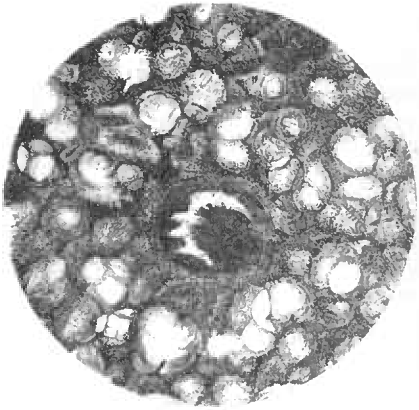


Fig. 2.
Microscopic section of lung in catarrhal pneumonia.

Fig. 3.
Microscopic section of intestine in "hog-cholera," showing healthy condition.

A.Hoen & Co.Lithocaustic. Baltimore.

tion of intestine from same animal shows a healthy condition. These three sections are transmitted with this report for verification. (See microscopic sections, Plate XV, Figs. 1, 2, and 3.)

The contents of the stomach and intestines were liquid in six cases, and dry, hard, and very dark colored in all others.

The gall-bladder usually contained a small quantity of thin, greenish fluid.

The trachea and bronchial tubes contained a large quantity of matter apparently consisting of mucus and broken-down epithelium.

DIAGNOSIS OF THE DISEASE.

Judging from the visible causes that appear most active in its development—the symptoms and pathology of the disease—we feel warranted in pronouncing it, in its milder manifestations, *bronchial catarrh*, and, in its most active and fatal form, *catarrhal pneumonia.*

There is no symptom uniformly present in the disease, as we have observed it, that bears any analogy to the symptoms of cholera as affecting the human subject, and the term "hog-cholera" is therefore a misnomer; and although there is, ordinarily, little or nothing in a name, in this instance the misnaming of the disease has been a source of incalculable loss, by suggesting a line of treatment irrationally administered and calculated to aggravate rather than cure it.

ITS CAUSE.

It is when seeking the cause of this wide-spread epidemic disease that the field of investigation takes widest range. As already stated, it prevails more or less at all seasons of the year, and under almost every conceivable condition and combination of conditions as to soil, food, water, locality, and general management; but the difference in its prevalence under certain circumstances is so marked and uniform that from these facts we may derive some definite information as to the causes *most* active in development.

The past history of the disease would indicate that it originated in this country at a time when the condition of swine was visibly altered from a comparative state of nature to one of more perfect domestication. When the country was new, affording almost unlimited range, the hogs bred, grew up, and roamed in the forest until maturity. Being allowed the free use of their noses, and being omnivorous in nature, they fed on worms, roots, mast, and such other food as was provided and given them by their owners; they exercised as their inclination or necessities inclined them; had free access to numerous springs and streams of running water; slept in storm-sheltered thickets on beds of clean leaves, and enjoyed under these circumstances a vigor of constitution and an immunity from disease unknown to the modern swine-breeders of the country. As the country became more densely populated, rendering it necessary to clear up and inclose the land for agricultural purposes, the lank, active, long-nosed animal of the pioneer age began to disappear in order to give place to a new and more advanced civilization in the history of his race. A close business calculation demonstrated that a hog fed to profit on food produced by manual labor must have an inbred tendency to take on flesh, and that tendency encouraged by close confinement and high feeding.

The hog of to-day is the result of persistent in-breeding for an obese habit, encouraged by want of exercise and over-feeding. An animal

quite comely in shape, early in maturity, of strongly-developed fattening tendencies, and of enfeebled constitution, is the intelligent and natural result. An animal thus deprived in part of the constitutional vigor of its ancestors, forced to give in part the instinctive habits of its race in obedience to the regulations of modern farming, must necessarily have acquired a diseased tendency. If, under these circumstances in the era of modern swine-breeding, the animal is more exposed to causes producing disease, a general prevalence of disease must be the result. Do such causes generally prevail, which, operating upon well-known principles in animal physiology, are calculated to produce the disease as we have observed it? If not, we are forced, in the absence of visible and rational causes, to indulge in hypothesis, and seek some hidden poison which, operating to produce the disease, may, therefore, propagate it by contagion.

We have assumed that the animal of the present period is one of impaired constitution, and that its habits, as imposed by the will of the farmer, as to food, water, cleanliness, exercise, and rest, do not approach so nearly a strict observance of the laws of health as do the instinctive habits of the animal in an unrestrained state of nature. The habits in the latter state have been briefly alluded to already. What are the altered conditions that conflict with the laws of health as imposed by the former state?

FOOD.

In considering this branch of the inquiry we will examine briefly the subject of food. The hog is an omnivorous animal; he eats both animal and vegetable food; his instinct demands and his health requires it. In his native state he obtains the animal food required by the industrious use of his nose in digging for worms and insects; but the most improved methods of modern swine-breeding have proclaimed the nose of the hog a useless appendage, and bred it to the smallest possible size—a thing of beauty to adorn a ring. The animal, thus deprived of the natural means of obtaining a supply of animal food, is forced to subsist almost exclusively upon vegetable diet, consisting almost wholly of corn. That this style of feeding long pursued is not conducive to the highest state of health would seem self-evident. In the hog-growing districts, corn alone is often the only food fed to swine from birth to slaughtering, and it is in these districts that the disease is most prevalent and fatal. On the contrary, hogs fed the offal from milk and cheese factories, or from city and hotel garbage, are always most free from disease. In the city of New Albany, Indiana, there are more swine to the square mile than elsewhere in the State; their rights are somewhat sacred; they run in every street, sleep in every alley, and break into almost every yard; as scavengers they constitute a sort of independent body of health police, auxiliary to the board of health; the average councilman regards them in some sense as his constituency, and the people, therefore, have vainly prayed for hog-ordinances and hog-cholera, and still the animal feeds upon our bounty, multiplies his race, and almost defies disease.

WATER.

During the dry months of the fall season it seldom happens that hogs have a proper supply of good pure water, even in well-watered districts of country. In all the herds examined where the disease prevailed, in but one instance was a proper supply of pure water observed; in a large number of cases there was positively no water, only thin mud at the

watering place. At the farm of Mr. Quinn, near Hartsville, Indiana, where the disease was prevailing, twelve head of sick animals were running in an inclosure, and when the proprietor was asked about the supply of water, he said, "There was plenty—a good spring." On personal examination the spring was found to issue from a hill-side, with but little incline; from the place where it issued to the point where it disappeared from exhaustion—a distance of some 40 feet—there was a long bed of thin mud, and no visible appearance of running water at any point. He was asked on our return when he last inspected the watering place, and answered, "This morning." He was then asked if he thought the supply of water at that spring would supply a few horses or cattle with water, if the hogs were taken out, and he replied promptly in the negative, and when asked by what process of reasoning he came to the conclusion that water of acknowledged unfitness for anything else was quite good enough for hogs, and sick ones at that, he replied, in substance, that hogs would not use water until they rendered it unfit for any other kind of stock!

We mention this case in detail because it fairly represents the views of the average farmer upon the subject of water for swine—"any water is good enough for a hog."

CLEANLINESS.

The domesticated animal does not approximate the habits of his pioneer ancestor in point of cleanliness. It is the instinctive habit of the animal to bathe in water and wallow in mud to counteract heat and as a protection against flies; but in a state of nature, when the mud has served its purpose, the animal cleanses himself by friction with the nearest tree; the filthy bed which the domestic animal becomes satisfied to occupy in a state of confinement is never occupied by animals running in the forest, and given opportunity to make and change their sleeping places at will—in short, when allowed to provide for his own existence, he exercises a more intelligent regard for his wants than is ordinarily exercised for him by his owner, who attempts to supersede instinct by reason.

The frequent allusions made to the native hog may provoke the inquiry, Are we to return to the ill-shapen and ungainly animal of forty years ago? Certainly not. In this age of high-priced corn, such an animal is unworthy of an existence. The only thing to be admired of him is his health and constitution; the only useful lesson to be derived from allusion to his history is the means by which these were acquired and maintained. Food, faulty in character and wanting in variety; water, deficient in quantity and purity; quarters, too limited in space and filthy in condition, are the three leading factors in the production of disease of swine.

Special attention was given to the examination of the surface land occupied by diseased animals, and while there were exceptional cases, in quite a large majority of instances they were running in fields producing quite a luxuriant growth of weeds which, during that season, were shedding their seed, bloom, and leaves. The earth was exceedingly dry and dusty. In traveling through the fields the animals created a dust from the earth and from the weeds also, which, together, were taken into the air-passages and lungs with the air breathed, constituting an active source of irritation. While pursuing this branch of the inquiry we were informed by some intelligent observers that they had noticed that animals running in such fields, particularly wheat and rye stubble, over-

grown with weeds, were the most unhealthy; and under these circumstances the greatest amount of disease was observed. It is at this particular season of the year that hogs are most neglected. Having been turned out during the summer months to take care of themselves, while the grass is green and filled with nutritious qualities, they thrive and do well; but, at the approach of the dry season, green grass gives place to that which is mature and dry, in which state it is indigestible and constipating. The water at this particular season fails. It is also at this season that swine keep their skin clothed with mud as a protection against flies, seriously interfering with its healthy functions as auxiliary to the lungs and other depurating organs of the body. This is the season when the cold nights precipitate heavy dews, and while running through the grass and weeds, during the nights and early morning hours, the animals become wet and cold, to be dried off and scorched in heat and dust at the returning noonday. During the nights they are chilled, sending the blood from the surface to the internal organs of the body, and breathe a damp, cold atmosphere; during the day they are overcome with enervating heat, and breathe a dry atmosphere, loaded with dust and dry particles of decaying vegetation. Is not this an array of existing circumstances well calculated to excite catarrhal affections, and are not these conditions as universally present over a large area of country as the disease itself? It may be objected that the disease sometimes prevails where the conditions mentioned are wanting. That it does prevail in some instances where there is no visible cause for its production is true, but the instances are of rare occurrence. As before stated, it prevails again in an active and fatal form during the months of February and March. This is the season when bronchial and lung diseases prevail among the human family, due to the atmospherical changes, and exposure to the damp earth then in a state of alternate freezing and thawing. Swine are similarly affected during that period of the year from the same cause; and being more generally exposed to these causes than the human family, are more liable to such diseases in their epidemic form. The principal objection to this rational theory of the cause of the disease is that it is found to exist at other seasons of the year than those mentioned, and under circumstances where almost all the conditions named are wanting. In a few instances we observed it where there was no visible want of first-class care in the management of the swine as to food, water, cleanliness, and shelter, and when they were running on clean blue-grass pastures well shaded and watered; but the prevalence of the disease under such circumstances *was exceedingly rare.* It is the general opinion among farmers that the disease is due to some specific poison, and is contagious in character. This opinion was generally entertained by the farmers of Putnam county, where the disease prevailed this season for the first time as a general and widespread epidemic. Many claimed that the disease was communicated by a lot of diseased swine driven through that county from the county of Boone; but many cases occurred on farms entirely off the route traveled by the diseased animals, and entirely isolated from public highways, and upon which no new or strange animals had been introduced by purchase or otherwise. A toll-gate keeper living near the village of Bainbridge, in that county, had a few swine running at large, and coming in close contact with all the animals driven over the road, and still they had escaped the disease; while those occupying inclosures by the roadside generally had it. Numerous instances were reported by reliable and intelligent men, where the disease prevailed upon one farm with but a partition fence separating the sick animals

from those of a neighbor, in an adjoining field, and the latter not be affected by it. No case of this kind was reported, where a stream of water led from the diseased herd to the opposite lot of animals, in which the latter escaped; which circumstance would indicate that while the disease may not be strictly contagious it becomes infectious, and can be transmitted by contact with diseased matter. Experimental operations conducted with a view to ascertain this fact were wanting, because of the lack of absolute knowledge that the animals operated upon would not have had disease without the introduction of diseased matter by inoculation; barring this doubt, the introduction of diseased matter into the system of a well animal produces the disease in four out of five cases. It is a safe practice to separate the sick from the well animals at the very first indication of approaching disease. The eating of the flesh of the dead animals, dying of the disease, by those surviving, is a very reprehensible practice, and should under no circumstance be allowed. The dead should be speedily removed and buried or cremated. Some farmers, however, claim that where they allowed the sick to eat the dead the animals seemed to recover faster by the practice—an observation, if correctly made, only demonstrating that the herd was suffering from want of animal food to such an extent that that furnished them in a diseased condition did them more good than harm. Those holding to the theory of contagion generally agree in the period of incubation as ranging from ten to twelve days.

Mr. William B. Taylor, of Martinsville, Ind., a gentleman of long experience as a feeder and packer, and an intelligent observer of the disease, states that when a herd of diseased animals were turned in a field with others not previously exposed, that the disease would almost invariably run through the entire diseased herd before attacking the others; and Mr. Joseph Goss, of Gosport, Ind., a feeder and packer of forty years' experience, and a most careful and intelligent observer, corroborates the statement of Mr. Taylor.

THE DISEASE AS AFFECTING DIFFERENT BREEDS.

This branch of the inquiry was forced upon our attention by certain parties who claimed in behalf of certain breeds of swine a partial or complete immunity from the disease. Unfortunately our field for observation in this regard was not good, since all the animals observed were grades in which the Poland-China and Berkshire blood largely predominated. The best information gained upon the subject was to the effect that the breeds for which such immunity was claimed were those not in general use, and that the absence of loss from such breeds is due to the small number of such animals existing in the diseased districts. Such claims were made in behalf of the Chester Whites and Jersey Reds. We saw none of either of these breeds in our travels, either sick or well. The latter breed may have a partial immunity from these considerations. It is an Eastern bred animal, developed in a section where in-breeding, close confinement, and over-feeding and monotonous diet are not so generally practiced as in the West, and that breed has, therefore, *possibly* a better constitution with which to resist diseased tendency.

RECURRENCE OF THE DISEASE.

All experienced feeders agree in the opinion that animals having the disease and recovering from it seldom have a second attack, and state that in purchasing animals to feed preference is always given to those

that have gone through with the disease. We are inclined to accept this opinion as of little consequence, for the reason that such as are fed for pork do not afford a sufficient lapse of time to clearly demonstrate this point; and, on the contrary, among breeding animals that are allowed to live older, in which timely opportunity is given, our information is that a second attack is not an unusual occurrence.

HEREDITARY EFFECT OF THE DISEASE.

Females having the disease when breeding almost invariably cast their young. If they escape that accident, the offspring usually die very soon after birth. Subsequent litters from the animal, after completely recovering from the disorder, do not appear to be wanting in vigor, and do not exhibit a greater aptitude for the disease than other animals.

PREVENTION OF THE DISEASE.

The widespread prevalence of the disease, its rapid course and dreadful fatality, warrant the opinion that measures of prevention, if discovered and applied, will be much more beneficial in result than the discovery of a successful line of treatment for the disease, unless that treatment shall consist of some specific remedy, a practical use of which can be made by the farmers in all stages of the complaint. That such a remedy will be discovered, we are of opinion, is not within the range of probability. The measures necessary to prevent disease in domestic animals embrace within their range a careful study of their natural habits and wants, and a strict observance of the laws of health that govern all animal life, the principles of which are the same in their application to the inferior animals as to man. Those errors alluded to when considering the cause of the disease, as, in our opinion, largely contributing to, if not wholly the cause of, its development, must be corrected. The idea that swine are exempt from the ordinary laws governing health, and will thrive under any and all circumstances, must be abandoned. Forced to keep pace in his superior development with the civilization of the age in which he lives, he requires additional care in his management in order to ward off the numerous ills to which he is liable, many of which were unknown to his race in its unimproved state of nature. The food of the animal should, at all times, consist of the greatest possible variety; the water drank should be strictly pure; too many animals should not be herded together; the young animals should be kept to themselves; frequent change of locality, by shifting from one field to another; the frequent plowing up or burning over of the lots usually denoted as hog-lots in order to disinfect them; frequent change of sleeping-places, and the removal and destruction of old, filthy bedding-material. During the dry fall months, when the swine are running at large, they should be daily inspected, and at the approach of that period when the succulent grass is giving place to the mature and dry, laxative food, such as bran-mash or oil-cake; or aperient medicine, as linseed-oil or Glauber salts, given to counteract the constipating effect of the dry grass; the watering-places daily inspected; if running in open fields with high weeds and grass, they should be taken out at night and kept from the cold, wet grass, and turned into woods, if there is such a place available; they should be kept from weedy and stubble fields during the dry dusty period of the fall season, both day and night. When confined in close pens, these pens should be cleaned daily, and disinfected when there is stench, by the use of copperas, chlorinated lime, or with dry,

fresh dirt. The opinion that corn, almost alone, is sufficient food for swine, and contains all that is necessary for the growth and development of the animal, will not be abandoned by the average farmer until after many costly lessons from experience, while attempting to freight their corn crops to market through this uncertain medium of transportation. A judicious and intelligent system of in-breeding cannot be abandoned without a rapid reversion to the ill-shapen animal of forty years ago, and we do not insist that in-breeding, when judiciously and intelligently practiced, is materially deteriorating in its influence upon the health and constitution of swine; it is only by coupling animals near related, that have a constitutional defect or a diseased tendency, and where these defects and tendencies are duplicated, that such a course becomes positively injurious. In the natural state of swine, when running at large and growing up without man's intervention, in-breeding frequently occurs; and the bad tendencies are warded off by the more vigorous males fighting off or destroying the feeble ones and becoming the sires of the race. Thus nature provides for a "survival of the fittest." In artificial breeding, the selections made for breeding purposes are too often made with special reference to shape and beauty, and too little consideration is given to vigor and constitution. There is no practical test made in the prize-ring between the most comely male and his less handsome brother, as to which is by nature best entitled to become the sire; but the breeder makes the choice from other considerations than "might makes right." Good feeding is the counterpart of good breeding; but there is a marked difference between good feeding and overfeeding or stuffing. Good feeding consists in giving an amount of good healthy food in sufficient variety to provide for the waste of the body, and in quantity only sufficient to develop the future growth of the animal. Overfeeding or stuffing consists in pushing the amount of food to the full assimilative capacity of the animal, with a view to the greatest possible amount of excessive flesh. The first is essential to good breeding; the other is deteriorating to the constitutional vigor of the animal.

TREATMENT OF THE DISEASE.

This branch of the subject we might sum up in these few words: No remedy was discovered having any marked beneficial effect upon the disease when once fully established; no farmer was found who ever in his own experience tried any remedy or remedies that seemed to exert any well marked curative effect upon the disease. Many isolated cases were reported; one animal recovered by having the tip end of its tail cut off; two, by being saturated with coal-oil, and a few others of like absurdity.

The announcement of the names of the individual members of the commission appointed to conduct this examination brought to our notice by letter a large number of so-called hog "cholera cures," which their several proprietors asked us to test, or allow them to test in our presence. As the requests were coupled with the expressed or understood condition that in case said remedies proved efficient cures their proprietor should have the benefit, for his private use and gain, of an official indorsement of the remedy, we did not think the investigation of such remedies for such purpose came within the range of duties properly devolving upon a commission appointed to make an investigation at the public expense for the public good, and therefore declined to answer all communications relating to such subjects. What valuable discoveries left in temporary obscurity by our course in the matter time alone must

disclose. We must say that in this matter we were not influenced by a strict regard to the observance of a high-toned professional code of medical ethics, but entirely from a sense of the proper discharge of a public duty. The sick herd of Mr. Quinn, previously alluded to, was taken as one offering a fair opportunity for treatment. The sick animals were all in the formative stage of the disease, and surrounding circumstances seemed favorable to their cure. They were confined to proper limits, in a pen well situated as to health and comfort, and were given a dose of purgative medicine as a starting point, consisting of Glauber salts. It was observed by all with whom we conversed that a larger per cent. of recoveries occurred from among those animals that at the commencement of the disease had vomiting and diarrhea than from others The dry and hard condition of the fecal matter found in the animals dissected leads to the belief that purgatives at the commencement of disease would always be a judicious course. Bromide of ammonia was then given in solution in doses of 30 grains every six hours. This remedy we tested at the suggestion of the Agricultural Department, at the instance of a gentleman who insisted that inasmuch as it exerted a salutary effect in the disease of cholera as affecting the human subject, it might prove equally beneficial in such disease in swine. So it might, but we did not find that an analogous disease, and therefore the remedy having no properties calculated to meet the character of the disease that *we did find*, proved of no practical benefit in its treatment, the animals dying in about the same proportion as when not subjected to any plan of treatment, but left entirely to themselves. Mr. Stadda's herd, in the same county, was subjected to the same plan of treatment with the same results. The herd of Mr. Thomas, in Harrison county, was treated under our direction by giving a mild purgative at the commencement of the disease, and during the acute inflammatory state of the complaint administered antimonials as a sedative to the circulation, and in the second stage tonics and nutritious food of milk, mill-feed, and vegetables, but the per cent. of deaths remained much the same as when not treated. Other isolated cases occurred under circumstances where extra care and effort was made in trying to effect a cure by several different lines of treatment, but candor compels the admission that as far as relates to the discovery of any plan of treatment proving sufficiently efficient to entitle it to respectable consideration, our efforts were without good results. And, lest our speculations and theories as to the proper line of treatment may be wrong, and present further obstacles in the way of the discovery of a successful remedy, we will refrain from giving them, preferring to present such points only as we fully believe will be of practical value.

I remain, very respectfully, your obedient servant,

D. W. VOYLES, M. D.

NEW ALBANY, IND., *November* 23, 1878.

REPORT OF D. E. SALMON, V. S.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In my investigations of the contagious hog-fever as it exists in North Carolina, it has been my endeavor to decide those points which it was indispensable for me to know before adopting preventive measures, rather than others which might be equally interesting from a scientific standpoint. What is the percentage of loss from swine disease in

this State? Is it one and the same disease from which the hogs are dying in the different parts of it? If but one, what are its symptoms, *post-mortem* appearances, nature, and cause? And what are the means by which such losses may be diminished or entirely prevented? These are the questions which it seemed most important to answer; they are those to which my time has been entirely devoted.

It was found very difficult to obtain information of localities in which the disease existed; for although requests were made through our newspapers for such information, and although, as I have since learned, swine were dying largely in every section of the State, I received during the whole time but three letters naming such localities. If to this we add that a large part of this State is without railroads; that the farms are large, and, consequently, the country is thinly settled; that usually but few hogs are kept on each place, it is seen that a great part of the time must have been spent in unproductive work in searching out infected localities, and, when these were found, in traveling from farm to farm to find herds suitable for experiment, or dead animals for examination. These facts must explain the small number of experiments which I was able to carry out.

To give a connected view of the subject, and one convenient for refer ence, the report is presented under the following headings:

I.

THE LOSSES OF SWINE.

a. Extent of disease, number and percentage of deaths.

b. Are the great bulk of these losses caused by one disease, or are they more equally distributed among all those to which these animals are subject?

II.

THE CONTAGIOUS HOG-FEVER.

a. Symptoms.
b. Post-mortem appearances.
c. Nature.
d. Cause.

III.

MEANS OF PREVENTION.

a. Hygienic and medical treatment.
b. Sanitary regulations.

EXTENT OF DISEASE, NUMBER AND PERCENTAGE OF DEATHS.

North Carolina is a State with a great diversity of soil and climate. In the western or mountainous part the summers are not excessively hot nor the winters extremely cold, and, with the exception of river bottoms which are of comparatively small extent, the soil is rolling and naturally well drained; the water is good; there is no malaria, and the country is rightfully considered a very healthy one. Extending from the mountains for two hundred miles eastward is a strip of country much of which is not sufficiently rolling for good drainage through the compact subsoil, and in a large part of which intermittent fever prevails to

a considerable extent among people. Still farther east is a strip of sandy and swampy country, extremely malarious, and very subject to intermittent fever and other diseases of malarial origin.

Now, if our hogs were dying of unhealthy surroundings; if their disease or diseases originate to any extent from malarious emanations, it is certainly in this eastern belt that we should expect to find by far the largest percentage of losses. We should not be disappointed in finding a few in the central belt, but in the healthy, elevated west, where the hogs roam in vast mountain forests, we should certainly expect an unusual freedom from disease, especially in summer. Viewing the matter from this standpoint, I visited the western and central sections, and would have gone to the seaboard if my own health had not failed me at this point.

Fortunately statistics have been collected of the number of deaths among swine in the different parts of the State for the year ending April 1, 1878; and these, as far as can be obtained (twenty-three counties only out of ninety-four), are as follows:

Counties.	Total number of swine.	Number of deaths.	Counties.	Total number of swine.	Number of deaths.
Bertie	22,286	5,151	Lenoir	16 604	3,853
Buncombe	12,076	3,194	McDowell	6,011	2,363
Burk	6,341	1,940	Martin	12,755	3,670
Camden	5,586	2,158	Mitchell	8,972	1,380
Chatham	27,858	9,103	Pender	14,964	1,977
Cherokee	5,183	538	Person	12,739	3,084
Clay	4,998	1,286	Richmond	10,030	1,192
Craven	11,446	3,493	Robeson	27,411	3,764
Cumberland	13,466	2,006	Rowan	14,409	1,943
Curritack	7,064	2,451	Wake	17,448	4,112
Franklin	16,045	6,359			
Guilford	22,392	1,041	Total	304,492	66,946
Hyde	8,358	888			

That is to say, hogs have died to an alarming extent from Cherokee, Mitchell, and Buncombe counties in the mountains, to Camden, Currituck, and Craven on the seaboard. Nor was the year above reported an exceptional one, as these losses are now being repeated in Haywood and Yancy in the west, and from thence in localities eastward to the sea. Speaking in round numbers we have reports here from one-fourth of the counties in the State, and these counties in 1870 contained about one-fourth of the hogs in the State, and contain now very nearly the same number as then. We may, therefore, estimate the losses in the entire State at four times the number in these counties, say 260,000. Taking the counties mentioned, the loss amounts to 21½ per cent. of the whole stock, and ranges from 38½ per cent. in Camden to only 4½ per cent. in Guilford.

ARE THESE LOSSES THE RESULT OF A SINGLE DISEASE?

This question has been raised again and again, whenever any measure has been proposed for diminishing the death-rate of these animals, and notwithstanding investigators in widely different localities have observed similar symptoms and similar *post-mortem* appearances, the great objection to sanitary laws has always been the uncertainty in regard to the affection or affections from which death occurred. It, therefore, seemed advisable to visit a large part of the State in order to decide this question of primary importance. The disease was seen by the writer in Haywood, Buncombe, and McDowell counties, in the mountain district,

in Rowan, Mecklenburg, Lincoln, Gaston, and Alamance, in the central belt, and particular inquiries were made of those who had observed it in the counties bordering on the coast. Several counties not enumerated above were visited, but I was not successful in finding infected localities. My greatest regret is that I was not able to make personal observations in every part of the State.

In each of the counties mentioned a considerable number of herds were visited and examined, and without exception the living animals presented similar symptoms, and the dead ones showed similar changes in the different organs of the body. Slight variations were of course observed, as is always the case in any disease, but these were as great between different individuals of the same herd, sick at the same time, as between different herds, even in different counties. And, what is of great importance, I did not find a single case in which it could possibly be supposed that death resulted from a local disease; but in every case a variety of organs, belonging to different apparatus, were found diseased; the blood often showed marked changes; there were extravasations in various parts of the body, and always inflammation of the lungs and large intestines, generally, also, of the heart, and often of the eyes; the skin, too, was often plainly affected, and the temperature was found to be increased before any other symptoms of disease were in the least apparent.

Considering all these facts, there can be no doubt that these animals all died of a general disease—a disease not caused by changes in any single organ; but, on the contrary, a disease which caused the various organic changes observed. Again, from the similarity of symptoms in all these cases which I saw, and in those reported to me from other parts of the State, and from the correspondence in *post-mortem* appearances, there can scarcely remain a shadow of doubt that the great mass of the hogs dying in North Carolina are affected by one and the same disease.

SYMPTOMS.

An increase of temperature precedes for an undetermined and probably variable length of time the appearance of all other symptoms. In one lot of seven ten-months-old pigs, only one of which showed symptoms of disease, the six remaining had a temperature varying from 103.6° F. to 106° F., and this temperature was preserved unaltered for six days, with no other changes in the condition of the animals than increased dullness of the eyes, a general unthrifty condition and a disinclination to search for food, although the appetite was still good. The pig first affected died about this time, and a *post-mortem* examination left no doubt of the disease.

In another lot of ten three-months-old pigs, but one of which was plainly sick, six had a temperature ranging from 104½° F. to 107° F.; with one this was 103½° F., with two 101° F. and 102° respectively, while with the sick one it reached 107.4° F.

In a herd of twelve, from which one had just died, and one was plainly sick, four others showed a temperature from 103½° F. to 107° F.

In a lot of fourteen animals, one had died, one was plainly sick, and three others had a temperature from 103° F. to 104° F.

Of five pigs, one had just died, three had a temperature of 105° F. to 106° F., and the remaining one 103° F.

Of eleven hogs, two had died, one was plainly sick, and five had a temperature ranging from 103° F. to 106° F.

From these and similar cases it has seemed probable that a high tem-

perature may exist several weeks before other symptoms are manifested, or even that the disease may in some cases be confined to, and run its course in, the blood, without a localization in any organ or organs. Such a view is also sustained by the often-observed fact that when the cholera exists in a herd, animals, which show no positive signs of sickness, are found in an unhealthy condition, and cannot be made to thrive and fatten. This point, however, remains to be cleared up by future investigations. An objection may be brought to the lower temperature here recorded, that according to other observers it is common to find a temperature of 103° F. to 104° F. in healthy animals. This, however, does not agree with the observations which I have been able to make. In one herd of ten, the last of a much larger number which had been reduced by this disease, all of which appeared healthy and thriving, not one showed a temperature by my thermometer as high as 103° F. In several other herds of healthy animals which I examined, but notes of which were not preserved, the temperature was found to range from 96° F. to 102½° F. In nearly all these cases the animals were called up from fields where they were running at liberty, and were immediately examined. So that, although there may be differences in thermometers, I think there can be little doubt from these observations that an increase of temperature precedes other symptoms by a number of days.

The first symptoms apparent externally are a dullness of the eyes, the lids of which are kept nearer closed than in health, with an accumulation of secretion in the corners; there is hanging of the head with lopped ears, an inclination to hide in the litter, to lie on the belly, and keep quiet; as the disease advances there is considerable thirst, more or less cough, a pink blush, rose-colored spots, and papular eruption on the skin, particularly along the belly, inside of thighs and fore-legs, and about the ears. There is accelerated respiration and circulation, increased action of the flanks in breathing, tucked-up abdomen, arched back, swelling of the vulva in the female, as if in heat; sometimes, also, of the sheath in the male; loss of appetite, and tenderness of the abdomen; occasionally there was persistent diarrhea, but generally obstinate constipation. In some cases large abraded spots are observed at the projecting parts of the body, caused by separation and loss of the epidermis; in these cases a slight blow or friction on the skin is sufficient to produce such abrasions. In many cases the eruption, blush, and spots are entirely absent; petechiæ were formed in about one-third of the cases; in one outbreak, chiefly confined to pigs in which the eruption was remarkably plain, there was considerable inflammation of and discharge from the eyes. Some animals have a very disagreeable odor even before death. In nearly all cases there is weakness or partial paralysis of the posterior extremities, and occasionally this paralysis is so complete in the first stages of the disease as to prevent walking or standing.

The percentage of animals affected and the violence of the symptoms vary greatly, according to the time the disease has existed in a locality. In the early part of an outbreak from 70 to 90 per cent. die, and most of these in the first stages of the disease, from deterioration of the blood or apoplexy. In one case there was a loss of 102 out of 107 head; in other cases whole herds of 30 or 40 succumbed; later, many of the animals linger for weeks, and finally die from persistent lesions of the lungs or bowels. In some instances a considerable number of those affected—20 to 25 per cent.—recover; many of these lose all their hair, and often the epidermis as well. Of those recovering, a very few fatten rapidly and do well, but by far the greater part cannot be fattened, and are always unthrifty and profitless animals.

POST-MORTEM APPEARANCES.

In about one-third of the cases petechiæ and larger blood extravasations are seen on the thinner parts of the skin; in a somewhat larger proportion of cases the abraded spots, already mentioned, are present; making a section through these, the skin appears thickened and of a very high color, but the sub-cutaneous tissue is not appreciably altered. In one or two cases there was no effusion in the abdomen, but in all the rest this cavity contained a variable quantity of liquid—sometimes of a bright yellow color and clear, sometimes of a straw color, and very often turbid and mixed with the coloring matter of the blood. In every case the colon and cæcum were plainly affected, reddened externally, and internally showed changes varying from simply a deep coloration to inflammation and great thickening; in some cases they were studded with petechiæ, in others there were none; ulcers of various sizes were frequently found, and also thickened fibrous, concentric patches, occupying sometimes nearly the entire walls of these organs. In one case there were large blood extravasations in the walls of both colon and cæcum, distending them to a thickness of half to three-fourths of an inch; on section, these spots had the appearance of a clot of black blood· they were firm and tough and did not yield to scraping with a knife Round, firm nodules, one-half inch in diameter, were frequently found in the walls of these bowels, which, on section, were of a grayish-white color, and appeared to be composed of compact fibrous tissue, with the exception of one case in which they were less firm, and presented the appearances of the extravasated-blood patches already described. With the exception of petechiæ the small intestine was nearly always normal; in one case there were two or three patches of inflammation one to two inches in diameter. The rectum was congested or inflamed in spots only; there were occasionally the nodular masses mentioned above, but in a majority of cases this part of the intestine showed little or no change.

The stomach in one-third of the cases was unchanged; in the remainder there were patches of inflammation from the size of the palm of the hand to the involving of half of the surface of this organ. Sometimes this was confined to the mucous coat, but often implicated the whole thickness of the walls.

The cavity of the thorax in every case contained a considerable quantity of a turbid, bloody liquid, in some cases nearly black in color; the pleuræ were generally thickened and covered with false membranes; the lungs were constantly found inflamed, occasionally in a few small spots only, but generally the greater part of the lung tissue was involved. Often these organs were greatly congested throughout, and would break down under the slightest pressure. The bronchial tubes were also found congested or inflamed, and contained considerable frothy mucus, which in some cases entirely filled them. The pericardium was in nearly every case distended with a turbid, blood-colored liquid, but no false membranes were discovered, and only in one case a piece of coagulated lymph the size of a hen's egg was found floating in this liquid. The heart seemed to be congested throughout in most of the cases, and had patches of a deeper hue than the rest on its external surface. These patches were very suggestive of inflammation, but in the absence of coagulated lymph this may be considered doubtful. This organ at times contained clots of blood of different consistency, and always of dark color, and at other times all the cavities would be found empty. In all cases the blood was very dark, and generally formed an imperfect clot, and the lymphatic glands were enlarged and greatly con-

gested. The larynx and pharynx were found normal in all the *post-mortem* examinations, but in some of the living cases there was considerable swelling about the larynx and ulcers on the posterior part of the tongue. The liver was generally as in health, though in some cases it was congested, spotted, and softened, and once was found smaller and more dense than natural. The bile was at times very thick and dark, and again very thin and of a bright yellow color. The spleen was normal in two-thirds of the cases; in the remainder it was slightly enlarged and softened. In two cases the interior was almost of a fluid consistency, while in one the organ was smaller and firmer than in health. The bladder was generally normal, but in two or three cases was inflamed and covered with blood extravasations about the neck, and contained in these cases bloody or very turbid urine. The kidneys were seldom more than slightly hyperæmic, but in a few cases there was considerable extravasated blood in the tissues about the hilum, and on section the substance about the pelvis was found infiltrated with perfectly black blood.

We have here a considerable variety of pathological changes, the only constant ones being congestion and inflammation of the lungs, colon, and cæcum, and congestion of the lymphatic glands. To mention any single peculiarities of these lesions as characteristic of this disease would not be possible from this investigation. Neither the thickened fibrous patches, the ulcerations, gray elevations of the intestines, the cuticular eruption, nor petechiæ were constant.

NATURE OF THE DISEASE.

In studying the nature of an unclassified disease the first question that occurs to us is: Is the affection a general or a local one? In other words, does the disease originate from functional or organic disorder of any particular organ or apparatus, or are the anatomical lesions developed secondarily as the consequence of a general affection? And this question, as regards the disease under consideration, can now be answered in a definite and satisfactory manner. Indeed, when we consider that the first sympton, and one preceding all others by several days at least, is an increase of temperature; that when localized a great variety of organs belonging to different systems and apparatus are involved, as, for instance, the nervous system, as shown by occasional paralysis and apoplexy, the lungs, pleura, bronchial tubes, heart, liver, stomach, intestines, spleen, kidneys, bladder, and skin; that there are considerable changes in the blood, as shown by imperfect coagulation, solution of the coloring matter, and blood extravasations, there can scarcely remain a shadow of doubt that the trouble is not a local but a general one.

The next question in logical succession relates to the contagiousness of the disease. Is its extension due to a principle which is multiplied in the bodies of sick animals, and which is of itself sufficient to cause the disease in healthy ones? In answering this question I will merely mention the experiments of Professors Axe, Klein, and Osler, which prove that the disease may be inoculated without detailing their facts; and I will only allude in like manner to the instances already recorded by Dr. Sutton, Professor Axe, and others, which seem to prove its highly contagious character. Most of these facts have been published in recent reports of the Department of Agriculture, and there is no need of repeating them. In my own investigations I have met with facts which entirely confirm the opinion of these observers in regard to this latter point. Thus I have found the disease to start at some point and spread slowly in different directions—not rapidly, as though depending on atmospheric conditions—and the rapidity of this extension depends to a very great degree on whether these animals are allowed entire liberty

or whether they are kept on the premises of the owner. In Mecklenburg county no stock is allowed to run at large, and the disease existed during the present year, in some localities, from early in the summer, and up to October first by far the greater part of the country was free from it; while in Alamance county, where no restraint is put on the animals, the disease spread from one extremity of the county to the opposite in a few weeks. In each of these outbreaks, and, indeed, in every one I have observed, it is no difficult matter to find one locality where the hogs have nearly all died and the disease has finished its work some weeks or even months before, while in almost every direction, at a distance of five, ten, or fifteen miles, these animals are just taking the affection; that is, the disease has extended and is extending, and it has required this length of time to travel this short distance. Can it be possible that an atmospheric or climatic change would travel no faster than this? Again, if dependent on such conditions, why do we find one township devastated by it and another not many miles distant entirely free from it? Such instances are very apparent in Haywood, Mecklenburg, Lincoln, and Gaston counties at this writing, and were not less so in Buncombe county in 1877. If it is claimed that this depends on the condition of the soil, it is only neccessary to reply that in the outbreak just mentioned, in Buncombe county, there are no facts to justify such a theory. In Swannanoa township, which is high, rolling land, with very few bottoms, no swamps or malaria, and which cannot be surpassed for healthfulness, the loss was 60 per cent. of the whole stock; while in Upper Hominy, which has no advantage over Swannanoa in healthful location, but which is more remote from thoroughfares traveled by western droves, the loss was only 2 per cent. It was probably entirely free from this disease.

A large number of instances could be produced of outbreaks in this State, particularly in the western part of it, clearly traceable to infected droves, and this is, above all, the case with the first introduction of the disease. It is difficult to establish exact dates, but all accurate testimony points to 1859 as the first appearance of this trouble. Some think the earliest outbreaks might have been a few years before that date, but of this I have been able to get no evidence. Mr. Morris, of Polk county, remembers that a drove stopped at his place in 1859; that some of the hogs died there of the disease, and that soon afterward this malady spread among most of the hogs in that locality. This was the first appearance of the trouble in that county. Mrs. Davidson, of Buncombe county, remembers that during the life of her father, who was a large hog-raiser, and who lived on the route followed by the droves, no hogs were lost by this disease, but that about the time of his death (1858) droves came through with sick animals, and that this was the first appearance of the disease in that locality. Many other people who cannot remember dates are positive in the opinion that the disease was introduced by droves from Tennessee and Kentucky. One man remembers that he was employed by the drovers to kill the animals that were sick and cure the meat. He also remembers that these animals had diseased lungs, and such a bad odor that they could scarcely be dressed. This was his first experience with the disease known as "hog-cholera." Colonel Polk, our present commissioner of agriculture, informs me that the first appearance of this disease in Anson county was in 1859; that it was undoubtedly brought there by western droves, and that these animals died to such an extent that the drovers took them secretly to the woods and buried them under brush and rails to conceal them. A drover who sold his hogs in Georgia at that time informed me that the disease was first introduced in that State in 1859, and that he had no doubt it

was carried there by the droves. Indeed, I have found but one opinion among those best informed on this matter, and that is, that the disease was never known in this section till introduced by animals driven from Western States; and in some sections of this State, a part of Alamance county for instance, the disease never existed till the present year.

Judging from all these facts, therefore, we cannot escape the conclusions that this disease is a contagious fever.

In this connection there is one more question that is generally raised by those discussing the nature of this fever, and that is, does the disease always originate from pre-existing contagious germs, or is it often or generally developed *de novo* as a result of improper hygienic surroundings? In the consideration of this question I shall confine myself to the facts brought out by the investigation in this State, simply premising that most of these facts are as true of the Middle States and probably of most of the Southern States as of North Carolina. The first point that attracts attention is the fact that this State was free from the disease till about 1859, certainly till it was introduced by droves from other States, whatever the date may be; hogs had been kept in this State from the time of its first settlement undoubtedly under similar hygienic conditions, and yet the disease had not appeared up to that time, when it was brought by imported animals, just as England was free from contagious pleuro-pneumonia up to 1842, when it was imported with animals from the Continent. It is claimed that in the west the disease is produced by overcrowding and filth, but I doubt if these animals are crowded any more now than forty years ago; indeed, I was surprised at the results of my investigations on this point, for, in all the time I have been visiting infected localities, I have not found a case of overcrowding, and not more than two or three where there was anything like filthy surroundings. In the western part of the State most of the hogs are kept in the large mountain forests, or are at least allowed the run of the highways and commons; in the east they either run in the highways and old fields or have ample pastures. If it originates from restricted range and unheathful climatic conditions, it is certainly in the east that we should expect to hear of its originating and proving most disastrous; but it was known in the mountains as early as in the other parts of the State. And if we examine the list of counties which I have given above, we shall find it as fatal in the elevated and heathful west, with its immense mountain ranges, as in the malarious east. I append some conspicuous examples of this:

Loss in eastern counties.	Per cent.	*Loss in western counties.*	Per cent.
Camden	38	McDowell	37
Lenoir	24	Buncombe	25½
Robeson	14	Mitchell	15½
Hyde	10½	Cherokee	10½

We find here, then, just as large losses in the west as in the east, and just as small ones in the east as in the west; in other words, the disease rages irrespective of these climatic and hygienic extremes; and this becomes still plainer when we add that in Swannanoa township of Buncombe county the loss reached 60 per cent.

Of course, at the present time, as with all contagious diseases which have existed for several years in a country, there are some outbreaks which it is impossible to trace to their source; and it seems probable that the contagion may be preserved over winter in manure, straw, litter, or in the remains of unburied animals which died the preceding year. There are some outbreaks that cannot well be explained otherwise, and, indeed, there is no reason to doubt that this may be the case; contagious

germs may also undoubtedly be carried a considerable distance by other animals or birds, and it is for this reason that many farmers have concluded that pasturing hogs on wheat-fields produces the disease; but hogs were pastured on wheat-fields as well thirty years ago as now; why did not the same result follow then?

I have concluded, therefore, after a careful study of these facts, that this contagious disease does not originate *de novo* in North Carolina; and that if the contagious germs now in the State can be destroyed and their importation prevented, we shall be as free from it in the future as we were before its first importation, about the year 1859.

HYGIENIC AND MEDICAL TREATMENT AS PREVENTIVES.

It was one object of this investigation to determine if the best hygienic conditions, clover pasture, large range, and variety of food have any preservative influence against this contagion; and while a large number of cases where these conditions seemed perfect could not be collected, the few that were observed prove that these alone are absolutely powerless to keep off the disease. Thus, Mr. Wadsworth, of Charlotte, lost 117 animals, nearly his whole stock, which had the run of a clover pasture and large wood lot, which had in addition slops from the city hotels, and grain. In this case disinfectants were freely used. Mr. Davidson, of Hopewell, lost 50 per cent. of his herd under similar conditions. A herd kept at a slaughter-house, in Charlotte, which had other food as well as the refuse, was the first to take the disease, and suffered to the same extent as others. Indeed I met with hundreds of cases where animals had large pastures and other food in addition daily, where such popular preventives as salt and ashes, sulphur, tar, oil of turpentine, charcoal, and copperas were freely and regularly given, where the majority of the animals were neither too fat to be vigorous nor so poor as to be wanting in this respect, and yet from 50 to 90 per cent. succumbed to this affection. In one case where I had the tincture of chloride of iron given regularly as a preventive, commencing before any of the animals showed even an elevation of temperature, and where they were in a large pasture at a considerable distance from any others, the disease has appeared; two have died and others will probably follow.

Some experiments were made with bisulphite of soda, salycilic acid, bichromate of potassa, and bromide of ammonia to determine if these have any power to arrest the disease when given before any symptom but increased temperature had appeared; the results of these were as follows.

Agents.	Number of animals.	Beginning of temperature.	Dose per day.	Length of experiment.	Final temperature.
Bisulphite of soda.				Days.	
Experiment No. 1	6	103.6° to 106° F.	4 drachms	7	96° to 99° F.
Experiment No. 2	4	103½° to 107° F.	1 ounce	4	102½° to 105° F.
Experiment No. 3	3	103° to 104° F.	1 to ½ ounce	7	103° to 106° F.
Salycilic acid.					
Experiment No. 1	4	104⅓° to 107° F.	30 grains	7	100° to 101° F.
Experiment No. 2	8	103° to 106° F.	45 grains	6	103° to 105° F.
Bichromate of potassa.					
Experiment No. 1	3	103½° to 107° F.	⅛ grain	7	103° to 105° F.
Bromide of ammonia.					
Experiment No. 1	4	103° to 106° F.	23 grains	7	103° to 106° F.

These experiments show that none of these agents can be depended on to stop the changes going on in the blood as a consequence of this disease. Although both bisulphite of soda and salycilic acid in one experiment each appeared to accomplish this, they failed in other cases where given in larger doses for an equal length of time; and when we consider that in no contagious fever has a remedy been discovered capable of arresting the course of the malady, the doubt in regard to the efficacy of these agents in this disease must increase.

SANITARY REGULATIONS.

We are finally brought to the irresistible conclusion that sanitary regulations properly framed and enforced are the only means at our command for checking the ravages of this disease and relieving our farmers from the enormous losses at present occasioned by it. We cannot expect, however, that this desirable object will be accomplished without considerable expense, especially in the first years of the attempt. We must expect outbreaks in all parts of the country where the disease has previously existed, caused by contagious germs which have been preserved in some of the ways already mentioned; but we should be encouraged by the fact that in most parts of the country, at least, these germs, unless especially preserved in straw, manure, remains of dead animals, &c., are entirely destroyed during winter. Thus, in Swannanoa township, where 60 per cent. of the hogs died in 1877, there has been no outbreak up to October 30, 1878. Above all must we realize the *necessity* of thoroughly destroying every particle of contagion wherever it appears. Although this would undoubtedly be very expensive, it would certainly be a great saving, even at the start, on the great losses which we are now annually experiencing; and if the work is thoroughly done we may expect that this expense will be reduced to a comparatively small item in the course of a few years. At the worst such expense would be much less than the use of a specific by individual farmers, even if such a remedy were discovered. In regard to such regulations I would suggest the following points as necessary according to what is now known of the disease:

1. The regulations should go into effect in winter or early spring when fewest animals are affected, or when, as my experience indicates, the disease is entirely extinct.

2. People living in localities where the disease has prevailed within two years should keep their hogs in an inclosure free from accumulations of manure, straw, litter of any kind, or remains of dead animals in which the contagion might possibly be preserved, and in which there were no sick hogs the preceding year.

3. That in such localities, *i. e.*, where the disease has existed within two years, it should be made obligatory for persons owning hogs to report each and every death occurring in their herds promptly (within forty-eight hours if but one, or twenty-four hours if more than one, or if others are sick), to a designated person to be located in every township or county, unless such deaths were plainly caused by mechanical injuries, drowning, maternity, &c. And that there should be districts established of convenient size, in each of which a competent veterinarian (or physician in case the veterinarian could not be obtained), should be appointed, to whom the above township or county officer should report whenever two or more such deaths have occurred in the same herd within a fortnight; whenever an unusual number of deaths have occurred in any locality, or whenever there is any reason to suspect the presence of this disease.

4. On receipt of such report the veterinarian should visit the locality and make a careful investigation into the nature of the disease, using the clinical thermometer and making *post-mortem* examinations.

5. If the contagious fever is indicated the whole herd should be slaughtered, the animals deeply buried, the place thoroughly disinfected, and no more hogs allowed there till after a succeeding winter.

6. When the disease exists to any considerable extent in a locality, those owning hogs in adjoining townships or even counties, according to the extent of the outbreak, should be required to keep them in small inclosures or pens, at a distance from roads or streams of water coming from infected localities. This is necessary to lessen the danger of infection and to allow more thorough disinfection in case the disease appears.

7. A certain compensation should be allowed for slaughtered animals—say 25 per cent. on a fair valuation for those plainly sick, 50 per cent. for those which simply show a rise of temperature above 103½° F., and full value for the healthy ones.

8. In case a hog-owner fails to comply with above regulations a penalty might be fixed, or at least such a person should receive no compensation for slaughtered animals.

These are the regulations that seem to me most necessary, but there may undoubtedly be circumstances in which these may be advantageously modified. Thus in case of a herd of several hundred animals, in which but few are affected and the remainder show a healthy temperature, it might be advisable to simply kill and bury the *affected* ones, to thoroughly disinfect the premises and to kill others as soon as a high temperature becomes apparent. Or in case all were killed the meat of the healthy ones might be preserved and marketed. It is also possible that, through negligence in making reports or an improper diagnosis of the disease, such a large territory may become infected as to make it advisable to establish a sanitary cordon, isolating the locality as much as possible; and leave the disease to run its natural course. In such cases no live hogs should be allowed to leave the infected section till after a succeeding winter, nor any carcasses of hogs till after freezing weather; people living within this district should be prohibited from going near swine outside of it, nor should drovers or others from outside be allowed to visit the infected swine. All dead animals should be promptly and deeply buried, and disinfectants freely used. All hogs in such district, and for twenty miles distance from it in all directions, should be kept in small inclosures at a distance from roads, in order to lessen the chances of extension and to allow thorough disinfection.

If such regulations are thoroughly carried out there can be no doubt that the ravages of the disease will be greatly diminished at once, and in a few years many States which now suffer terribly from it will be completely exempt; while in those where it now proves most disastrous there is reason to believe it would never cause serious losses. Sanitary regulations similar to these are the only means that have ever been successful in combating the contagious diseases of animals, and while we would not be understood as discouraging the search for specific remedies we cannot disguise our opinion that it is extremely irrational and absurd to delay action in this disease till such specific shall have been discovered; in other words to neglect those measures which have alone succeeded and cling to those which have always failed.

Respectfully submitted.

D. E. SALMON, *V. S.*

SWANNANOA, N. C., *November* 15, 1878.

GLANDERS.

EXPLANATION OF ILLUSTRATIONS.

[These illustrations of photographic copies of the plates accompanying Professor Gerlach's treatise on glanders, published in the *Jahresbericht der Koeniglichen Thierarzneischule zu Hannover*, 1868. The same illustrate the morbid anatomy of glanders.]

PLATE I.—FIG. I. Development of glanders-cells of connective-tissue corpuscles in the mucous membrane of the septum. Enlargement 300.

1. Spindle-shaped cells, with a large oval nucleus.
2. The same, more swelled; nucleus larger; a second nucleus developing.
3. Cells like No. 2, but with ends blunted; more granulated and approaching decay.
4. Round cells of different size, with a large nucleus; the largest ones have a dark, granulated nucleus; beneath free nuclei and granulated detritus.

FIG. II. Microscopic cut from gray-yellowish glanders; nodules of the mucous membrane of the septum, in which (cut) can be seen spindle-shaped cells in differeut stages of development to round cells with a fibrous intercellular substance. Enlargement 300. At *a* the spindle-shaped cells and at *b* the round cells prevailing.

FIG. III. Development of glanders-cells of epithelium elements in the pulmonal nodules. Enlargement 300.

1. Normal cylinder-cell with a nucleus.
2. Cylinder-cell with a second nucleus developing.
3. Cylinder-cell with two and three developed nuclei.
4. Bag-shaped rudiments of cylinder-cells filled with young round cells.
5. Giant-cells with young round cells.
6. Small and large round cells with a large, dark, and granulated nucleus.

PLATE II.—FIG. IV. Lower end of the septum with glanders-nodules and ulcers. (Natural size.)

1. Various gray glanders-nodules.
2. A group of glanders-nodules with a round hole in the middle. (Incipient glanders-ulcers.)
3. A solitary glanders-ulcer.
4. Confluent glanders-ulcers with elevated borders and dirty bottom.

FIG. V. Transversal cuts through the gray nodules in the mucous membrane of the septum. (Natural size.)

a. Gray nodule in the midst of the tissue of the mucous membrane; the upper layer of the mucous membrane raised.

b. Gray nodule in the upper layer of the mucous membrane, visible on the surface.

FIG. VI. A piece of the lower border of a lung, cut surface. (Natural size.)

1. Miliary tubercles.
2. Tubercle of the size of a pea.
3. A large glanders-nodule developing.

FIG. VII. Also a piece of the lower border of a lung, cut surface. (Natural size.)

1. Miliary nodules surrounded by a red crust.
2. Large gray glanders-nodule (glanders excrescence) growing yet in one direction

GLANDERS.

Report Commissioner of Agriculture for 1878. **Plate I.**

Fig. I.

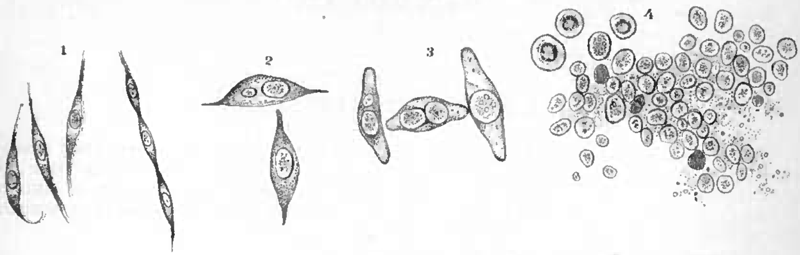


Fig. I.
Development of glanders-cells of connective-tissue corpuscles in the mucous membrane of the septum.

Fig. II.

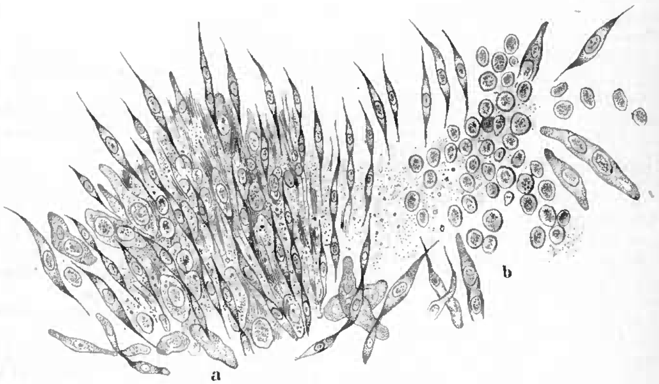


Fig. II.
Microscopic cut from gray-yellowish glanders.

Fig. III.

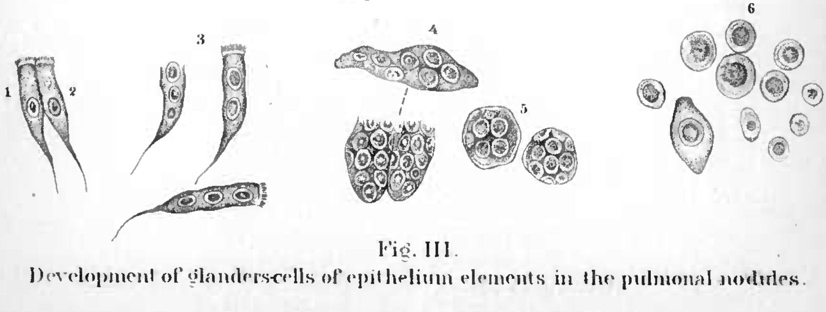


Fig. III.
Development of glanders-cells of epithelium elements in the pulmonal nodules.

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GLANDERS.

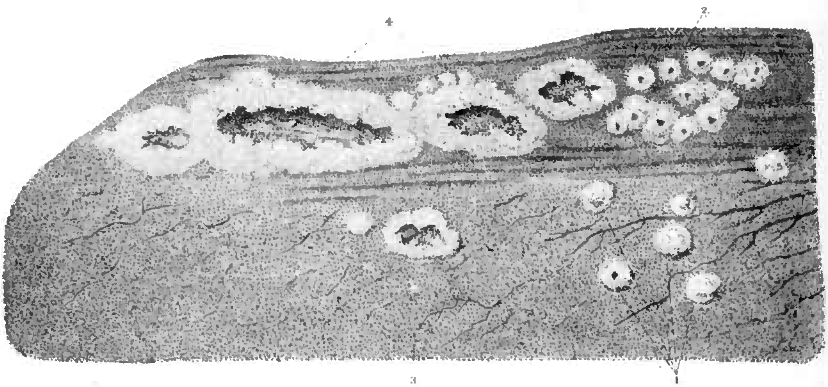

Fig. IV.
Lower end of the septum with glanders-nodules and ulcers (natural size).

Fig. V.
Transversal cuts through the gray nodules in the mucous membrane of the septum (natural size).

Fig. VI.
Piece of the lower border of a lung cut surface (natural size).

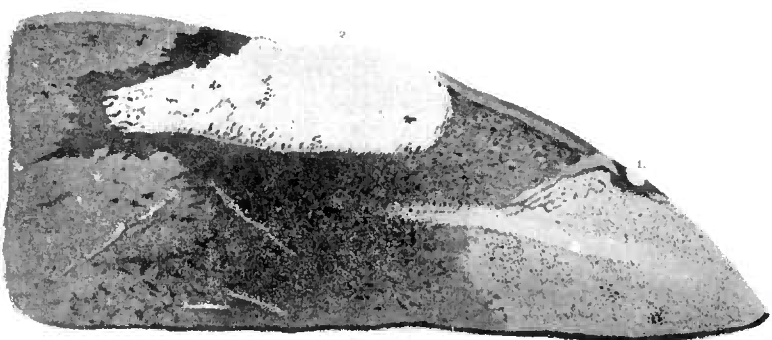

Fig. VII.
Also a piece of the lower border of a lung, cut surface (natural size).

A.Hoen & Co.Lithocaustic Baltimore.

GLANDERS.

By Dr. H. J. Detmers, V. S., *Chicago, Ill.*

Definition.—Glanders is a contagious disease *sui generis* of animals belonging to the genus *equus*. It has usually a chronic course, can be communicated by means of its contagion to several other species of animals and to human beings, and must be considered incurable if fully developed. The principal seat of the morbid process is usually in the mucous membrane of the nasal cavities. Three main symptoms, viz., discharges from the nose, swelling of the submaxillary lymphatic glands, and particularly ulcers of a peculiar, chancrous character in the mucous membrane of the septum of the nose, characterize glanders, and are, therefore, of the greatest diagnostic value. Wherever these three symptoms, or only two of them, are present and fully developed, there the diagnosis is secured. But unfortunately this is not always the case; sometimes two, and even all three, principal symptoms may be wanting, and still the horse may be affected with glanders. In such a case the seat of the morbid process is not in the nasal cavities, but further on in the respiratory passages, or even in the lungs. Several such cases have come to my observation, and have also been described by others, especially by Professor Gerlach. In still other cases, in which the disease might be called "external glanders," but is better known by the name of "*farcy*," the morbid process has its principal, or even its exclusive, seat in the subcutaneous connective tissue and in the skin or cutis. The late Professor Gerlach, in his treatise on Glanders, published in the "*Jahresbericht der Koeniglichen Thierarzneischule zu Hannover*, 1868, discriminates, in consequence of these differences, three distinct forms: Nasal or common glanders, pulmonal glanders, and farcy. As such a division of glanders proper into nasal and pulmonal glanders—farcy is described by every author under a separate head—facilitates considerably the diagnosis, and explains also at once why just those symptoms which are usually looked upon as most characteristic remain sometimes imperfectly developed, or entirely unobserved, it will be convenient to adopt Gerlach's classification.

1. Nasal Glanders.—This form is that which is most common, best known, and characterized by the three principal symptoms which have been mentioned.

(*a.*) *The discharge from the nose*, although the most conspicuous of those three symptoms, is really the one which is the least characteristic, or of the least diagnostic value, because several other diseases of the respiratory organs are also attended with discharges from the nose, which are more or less similar. It is true, the discharge in glanders possesses some properties which, if considered as a total, are characteristic and are not found combined in any other disease; but the difficulty is one or another of these qualities is not always sufficiently developed. Consequently, if the other two principal symptoms, the swelling of the lymphatic glands and the ulcers in the nose, are absent or not observed, the discharges from the nose are seldom characteristic enough to serve as the sole basis of a reliable diagnosis. The same are frequently one-sided, and, according to most authors, oftener from the left than from the right nostril. According to my experience they are nearly, if not quite, as often from

the right as from the left nasal cavity, and, at any rate, just as often from both nostrils as from one only, but always more abundant from one, either right or left, than from the other. At the beginning the discharges are usually thin, almost watery, frequently greenish, or somewhat similar in color to grass juice; afterward the same appear to be composed of two different fluids, one yellowish and watery and the other whitish and mucous. Still later the discharges become thicker, more sticky, exhibit frequently a mixture of different colors, are sometimes greenish, sometimes dirty white or grayish, contain not seldom streaks of blood, and, in advanced stages especially, particles of bone or cartilage. They have a great tendency to adhere to the borders of the nostrils and to dry there to dirty yellow-brownish crusts. As to quantity, the nasal discharges in glanders are seldom very copious, at least not as copious as in many other diseases—strangles, for instance. The quantity, however, varies. Sometimes, especially when the weather is warm and dry, the discharges may be very insignificant or be absent altogether, and, at other times, particularly if the weather is rough, wet, and cold, will increase in quantity and become comparatively abundant. Several authors have attached special importance to one or another of the various properties as something characteristic, by which the nasal discharges in glanders can be distinguished from those of other diseases, but, in reality, none of those properties are constant enough, or belong exclusively to glanders, to be alone of great diagnostic value. Solleysel and Kersting considered the stickiness as such a characteristic, but the discharges in strangles are frequently just as sticky. Pinter and Vitét relied upon the specific gravity; they found that the nasal discharges of glanders, which consist partly of matter and partly of mucus, sink to a certain extent in water, while the mucus discharges of distemper swim on the surface. This test is of some value, but is not decisive, because matter is sometimes admixed also to the nasal discharges of other diseases. Others have laid stress upon the one-sidedness of the discharge, but the latter is just as often from both nostrils as only from one, and a one-sided discharge belongs also to some other diseases; is, for instance, observed in a catarrhal inflammation of one of the frontal or maxillary sinuses, if caries in one of the three last molars of the upper jaw has effected a fistulous opening into the maxillary sinus, if a polypus has developed in one of the nasal cavities, &c. Professor Gerlach considers the greenish color as a very important characteristic, but that, too, is not reliable, because it is not constant, is usually observed only at the beginning, and belongs frequently, also, to the nasal discharges of catarrh, strangles, and influenza, if the patients are kept on green food or in a pasture. The nasal discharge constitutes a characteristic symptom of glanders only, if all its essential properties are present (sufficiently developed), and are considered as a whole. If the other principal symptoms (swelling of the lymphatic glands and ulcers in the nasal cavity) are absent or remain unobserved, some minor symptoms, which may happen to be present, and the absence of all such symptoms which are peculiar to other diseases, make frequently a diagnosis possible.

(*b.*) *A distinctly limited swelling of the submaxillary lymphatic glands* constitutes the second essential symptom, which is more characteristic of glanders, and of greater diagnostic value than the discharge from the nose. The swelling corresponds to the discharge; that is, if the latter is one-sided, for instance, from the left nostril only, the glands of the corresponding left side of the head are affected, and if the discharge is from both nostrils the glands of both sides are swelled, but always those

of that side the most on which the discharge is most copious. The swelling does not exhibit any conspicuous sign of inflammation, and is usually not painful, except at the beginning or after a sudden increase of the morbid process. It is always distinctly limited, and the swelled gland is always hard and usually of the shape and size of a peanut; may occasionally, however, be found as large as a hen's egg. Large inflammatory swellings without distinct limits do not belong to glanders. At first the swelled glands are more or less movable beneath the skin, but afterwards, in an advanced stage of the disease, the same frequently appear to be attached more or less firmly to the bone and are immovable. The swelling, unless irritated by external causes, never dissolves in suppuration like the inflammatory swellings common in distemper, and is absent only if the lymphatic glands have been extirpated, if the lymphatics have become obliterated, or if the morbid process in the mucous membrane of the respiratory passages is situated too high to be within the province of those lymphatics which are connected with the submaxillary glands, for the swelling is caused solely by a deposit of deleterious matter which has been absorbed by the lymphatics. Professor Gerlach looks upon every horse as probably affected with glanders which shows a distinctly limited, hard, knotty, and painless swelling of the submaxillary lymphatic glands. I will not contradict a man of his experience and learning, and admit that such a swelling constitutes a very suspicious and characteristic indication of glanders, especially if some other symptoms of that disease are also present; but I am obliged to remark that I have seen horses not affected with glanders in which those glands were swelled to the size of a peanut, and were hard, without pain, and movable.

(*c*.) *Ulcers of a peculiar, chancrous character* on the mucous membrane of the nose, and especially of the septum or cartilaginous partition between the nasal cavities, constitute by far the most characteristic symptom, and, in fact, the only one which makes the diagnosis a certainty, even if all other symptoms should be absent or imperfectly developed. Still, such is never the case; if there are ulcers in the nose, then there is also a discharge of matter mixed with mucus from the corresponding nostril. In some cases these ulcers are present, but are situated too high to be seen unless the horse is examined in bright sunlight and the rays of the sun are reflected by a mirror into the cavity of the nose. The seat of the ulcers is usually on the septum and near the nasal bone. Their size and shape vary (Fig. IV). Some ulcers are small, isolated, almost round; others are large, of an irregular shape, and of uneven depth. All produce matter, have elevated, corroded borders, a dirty, steatomatous-looking bottom, and are never covered with a scab. At first small gray specks or elevated gray spots (glanders-nodules), varying in size from that of a pin's head to that of a pea, make their appearance (Fig. IV, 1 and 2, and Fig. V, *a* and *b*). These nodules soon decay and form ulcers. Gradually the ulcers increase in size and depth (Fig. IV, 3); their borders become more elevated and corroded; the process of decay goes on; and if two or more small ulcers are close together, they become confluent, unite, and constitute one large, irregularly-shaped ulcer (Fig. IV, 4), which continues to increase in size and depth. Decay and destruction work their way deeper and deeper, even into the cartilage, and if ulcers happen to be existing in both cavities, or on both sides of the septum, it occurs not seldom that the latter becomes perforated. I observed several such cases, one especially in Lee Centre, Lee county, Illinois, in 1866, in which the hole in the lower or anterior

part of the septum was fully as large as a silver half-dollar. The borders of the same appeared irregular, corroded, much swelled or elevated over the surface of the septum, and coated with a dirty-looking, discolored, and blood-streaked glanders-matter. The disease, in that case, was far advanced, and the animal about ready to die.

Sometimes it happens that a glanders-ulcer shows a tendency to heal; it loses its chancrous character; granulation makes its appearance; a scurf or scab is formed; a healing takes place, and a fibrous, whitish-colored, somewhat puckered or star-shaped scar is left behind.

Some authors have attached considerable diagnostic importance to a bluish or lead-gray color of the nasal mucous membrane, and to bluish or lead-gray spots, which usually make their appearance before it comes to ulceration. Such a bluish color, however, is not a constant symptom—in some cases only small red specks can be seen on an otherwise rather pale mucous membrane, and is not characteristic either, because it is observed also in catarrhal diseases, and in horses driven against the wind in cold weather.

(*d.*) *Minor symptoms.*—The three principal symptoms just described are usually accompanied by some others of minor diagnostic value, but under certain circumstances very important, especially if one or another of the principal symptoms should happen to be imperfectly developed. As such minor symptoms, may be mentioned, first, an accumulation of a glassy, whitish-gray mucus in the inner canthus or corner of the eye of the diseased side of the head. It is a symptom which usually makes its appearance at the beginning of the disease; second, a lusterless, dry, and dirty-looking, or so-called "dead" coat of hair; third, more or less difficulty in breathing; fourth, a peculiar short and dry cough, somewhat similar to the well-known cough of a horse affected with heaves. These last three symptoms, of which the cough is the most characteristic, make their appearance only after the morbid process has made considerable progress. In some cases the plain outbreak of the disease, or the appearance of plain and unmistakable symptoms, is preceded by a swelling of the inguinal, the axillary, and other lymphatic glands.

The difficulty of breathing, and the peculiar and somewhat characteristic cough, though only minor symptoms in common or nasal glanders, rise to great diagnostic importance if the morbid process has its principal seat in the lungs instead of the mucous membrane of the nasal cavities—if, in other words, the animal is affected with that form of the disease which Professor Gerlach has called "*pulmonal glanders.*"

It happens sometimes that a horse is affected with glanders and communicates the disease to other healthy animals, but does not itself show any of the three principal symptoms characteristic of that disease; has no discharge from the nose, no swelled glands, and no ulcers in the nasal cavities. The late Professor Spinola, in his lectures on veterinary pathology at Berlin, related such a case to his students, which will serve as an illustration. It is substantially as follows: In a village near Berlin glanders broke out in a stable in which several horses were kept. A veterinary surgeon was called, who made an investigation and condemned every horse that showed any symptoms of the disease, and every animal condemned was immediately killed. The horses apparently not affected were kept for several weeks under police control, and from time to time inspected, but finally released. Among them was one old sorrel horse which had the heaves, and which had been brought into the stable a short time before the first case of glanders made its ap-

pearance. This sorrel horse soon after was sold to a man in another village, and came into a stable containing also quite a number of horses. In that stable, too, glanders broke out. A veterinary surgeon (another one) was called, and every horse showing symptoms of glanders was condemned and immediately destroyed. The old sorrel horse, however, which was known to have "the heaves," was again released after some length of time, together with those which had remained exempted, and was sold once more, this time to a man who kept over 30 horses (I have forgotten the exact number) in his stable a few miles from the city. In this last stable glanders likewise made its appearance after some lapse of time, but in that case Professor Spinola was called. He, too, after a careful investigation, condemned every horse that showed any symptom of glanders, and insisted upon condemning also the old sorrel horse, whose history was then unknown to him, notwithstanding that no symptoms of disease, except such as are usual attendants of heaves, could be observed. The owner hesitated to consent to the loss of a horse apparently not affected with glanders, but Spinola insisted upon the condemnation. The *post mortem* examination revealed that the old horse, which had the "heaves," was affected with pulmonal glanders in a very high degree; and Spinola, after learning the history of the old sorrel, was convinced that the latter had caused the outbreak of the disease in all three stables. Professor Gerlach, in his valuable treatise, cites several cases, which to relate would lead too far. Some cases, though not so strking as that related above, have also come under my own observation. In pulmonal glanders the morbid process has its principal seat in the lungs, and may remain limited to the latter for months, and even for one or two years; and during that time, or as long as the morbid process is confined to the lungs, no prominent symptoms may make their appearance except such as are usual attendants upon heaves—some difficulty of breathing, and a peculiar short, weak, and dull cough, which must be heard, but is not easily described. Finally, however, but not before the disease has made considerable progress, the difficulty of breathing increases, more or less discharge from the nose makes its appearance, emaciation sets in, the natural glossiness of the coat of hair disappears and becomes rough, stands on end, and exhibits a so-called dead and dirty-looking appearance. The skin, too, loses some of its natural elasticity, and the animal becomes "hide-bound."

The morbid changes are revealed only at the *post mortem* examination. Smaller and larger glanders-nodules (usually called tubercles) present themselves in different stages of development and subsequent decay in the tissue of the lungs. Some of them present themselves as formations rich in glanders-cells (see illustrations), and others, especially if the disease is of long standing, as decayed, cheesy, dried, and shrunk substances and glanders-tumors of a sarcomatous and fibroid character. In some of the oldest ones even a deposit of lime-salts may have taken place. I remember one case, which occurred in Germany, a few miles from my residence, about twenty years ago, when I first commenced to practice. I was called to examine a horse suffering from some pulmonal disorder. The symptoms were those of pulmonal glanders in an advanced stage of development; even nasal discharges had made their appearance. I diagnosticated glanders, but being young and without much experience, declined to take the responsibility of condemning the horse, because the laws of Germany are very strict in that respect, and provide that every horse affected with glanders be destroyed immediately. I therefore reported the case, not to the proper executive authorities, but to the

veterinary surgeon-general, who, at my solicitation, came immediately and examined the animal. He did not pronounce it a clear case of glanders, but doubted, at least hesitated. The owner, however, consented voluntarily to have the horse killed. The *post mortem* examination revealed pulmonal glanders in a very advanced stage. A similar case, of which I shall have to give a brief account in another chapter, I had an opportunity to observe in 1866, near Dixon, Lee county, Illinois.

As the principal symptoms of pulmonal glanders are essentially, for some length of time at least, only such as are also observed in common cases of heaves (one of the most frequent disorders of horses), the diagnosis must frequently be based, as a lawyer would say, upon circumstantial evidence.

A horse must be suspected of being affected with glanders, first, if the peculiar, weak, and dry cough constitutes, compared with the difficulty of breathing, the predominating symptom; if the animal becomes more and more emaciated and hide-bound, and if the appearance of the coat of hair is such as to indicate the presence of a cachectic disease. Second, if it is known that the animal in question has been exposed to the contagion. Third, if other horses have become affected with glanders or farcy, after having been together with the animal that shows those symptoms. Fourth, if a horse apparently affected with heaves has previously exhibited other symptoms, more or less characteristic or suspicious, of glanders. Fifth, if other symptoms, such as are observed in so-called "nasal gleet," or incipient nasal glanders, make their appearance.

3. FARCY, OR EXTERNAL GLANDERS.

The name "farcy" is given to such cases of glanders in which the morbid process has its seat in, and immediately beneath, the skin, and in which nodules, boils (glanders-buboes), and ulcers of a very infectious and chancrous character make their appearance in the subcutaneous tissue, and in the skin itself. Glanders-nodules and lenticular ulcers in the tissue of the skin, boils beneath the skin, smaller and larger open ulcers penetrating the same, a strand-shaped swelling of the subcutaneous lymphatics, swelled lymphatic glands, and œdemata, the latter especially in the legs and on the head, constitute the most essential symptoms.

Professor Gerlach discriminates two forms: Subcutaneous glanders or common farcy, and exanthematous glanders or skin farcy.

(*a*.) *Subcutaneous glanders or common farcy*.—The morbid process in this rather frequent disease has its principal seat in the subcutaneous connective tissue, and in the lymphatic system of the skin and between the skin and the muscles, but especially on the inner side of the hind legs, on the lips, on the neck, between the fore legs, and on all such places where the skin is thin and fine. At first distinctly limited swellings of an inflammatory character (incipient boils or glanders-buboes) make their appearance in the subcutaneous tissue. These swellings or boils soon commence to dissolve, or to decay, from within; the ulceration begins in the center, but the matter, being very corrosive, soon works its way into the skin, the boil finally opens, and presents a farcy-ulcer with a steatomatous bottom, and elevated, corroded, and inflamed borders. At the same time, or even before the formation of the first ulcer has become completed, deleterious matter is absorbed by the nearest lymphatics, and deposited in the lymphatic glands. The former, in consequence, swell to hard and plainly visible cords or strands, and the latter to painful and distinctly limited tumors. The partial or total

closing of the lymphatic vessels and glands thus effected interferes with, and even prevents, a performance of their functions, or stops the absorption of lymph, and œdematous swellings, more or less extensive, are the necessary consequence. The same make their appearance especially if the seat of the morbid process is on the inside of a leg, and if either the inguinal or axillary glands are swelled and closed by a deposit of deleterious matter. The more extensive and complete the swelling and closing of the lymphatic vessels and glands, or the more lymphatics are affected, the more extensive is also the œdema. Lameness, usually caused by such an œdema, is also a frequent attendant.

The roundish boils or tumors increase in size from that of a hazel-nut to that of a hen's egg. At first, when such a boil is making its appearance, it is not fastened to the skin; the latter can yet be moved a little in every direction over the boil, but soon the neoplastic process and the subsequent decay will extend to the tissue of the skin, and boil and skin will become firmly united before the ulcer breaks and discharges its extremely infectious and corrosive contents, consisting of decaying glanders-cells or matter, and lymph.

(*b.*) *Exanthematous glanders or skin farcy.*—In this form of glanders or farcy the principal seat of the morbid process is in the tissue and in the lymphatics of the skin or cutis. It is a rare form in horses, but the only one in which external glanders or farcy makes its appearance in a human being. Distinctly limited swellings (nodules and tumors) of the size of a pea to that of a hazel-nut, either isolated, or united and resembling a string of beads, make their appearance in the tissue of the skin. These swellings soon break, and then present round ulcers with elevated and corroded borders. The discharge consists of a mixture of matter, composed mainly of decayed glanders-cells and lymph. In other, though rather rare cases, the swellings are very small and numerous, and present themselves as small nodules, some of which are so small as to be scarcely visible, while others are about as large as common peas. These small swellings, too, are soon changed to ulcers, which are usually flat, lenticular, and constantly suppurating. If close together the same become frequently confluent. Only one case of skin-farcy has ever come under my observation. It was about five years ago, at Manhattan, Kans. Numerous small ulcers were crowded closely together on the nose and the muzzle of the horse, which was also affected with nasal glanders.

On the human skin, not being covered with hair, the whole process can be observed much better than on the skin of a horse. Professor Virchow's description of skin-farcy in men may, therefore, find a place. Virchow says:

At first these spots are much reddened, but very small, almost like flea-bites; then papular swellings are formed; the surface of those swellings rises gradually rather in the shape of a round and solid elevation than of a pustule, and assumes a yellowish color, which gives it a pustulous appearance. If the epidermis is removed from such a flat or roundish papule or nodule, which is not depressed in the center, but surrounded by a swelled and reddened court, a puriform, moderately consistent yellowish fluid is formed, which contains but few organized constituents, and consists mainly of the decayed elements of the formerly solid nodule. The fluid, therefore, is not lodged in a pustulous elevation of the epidermis, but in a small hole in the corium, which penetrates the latter as if it had been made with a punch. After some time the fluid (matter) becomes colored by hemorrhagic admixtures; still later its color is changed to bluish red, and finally small brown or blackish crusts or scabs are formed. Such eruptions appear sometimes in enormous numbers on the whole body.—(Gerlach's Treatise.)

Nasal gleet.—This is a name which I have accepted only with great reluctance, because it signifies no definite disease, and is used frequently,

as I shall hereafter have an opportunity to show, to cover ignorance, fraud, and crime. It can be retained only if applied exclusively to such cases of disease (usually occult or incipient glanders) in which the horse has a suspicious-looking discharge from the nose, but shows no other characteristic symptoms sufficiently developed to base upon them a sure diagnosis. So, for instance, it may happen that a horse has a chronic discharge of matter and mucus from one or both nostrils, and, perhaps, also a distinctly limited swelling of the submaxillary lymphatic glands, and yet neither the discharge nor the swelling may be sufficiently characteristic to justify the decision that the horse in question is affected with glanders, because the latter is a disease which, for obvious reasons, demands a correct and positive diagnosis. To declare that a horse has glanders is equal to condemning the same to be killed. The term "nasal gleet," therefore, is convenient and admissible, if used exclusively to signify a disorder of the respiratory organs attended with suspicious discharges from the nose, and other symptoms common in glanders, but not yet fully enough developed or sufficiently characteristic, one way or another, to make the existence or absence of glanders a certainty. Such a disorder, of course, must be considered as incipient or occult glanders till every doubt has been removed.

Chronic and acute glanders.—Glanders, as a rule, is a chronic disease. The morbid changes develop slowly. Of the various forms in which the disease is able to make its appearance, pulmonal glanders, unless complicated with one of the other forms, or with other inflammatory or feverish diseases, is the most chronic, or takes the longest time to produce conspicuous symptoms and to become fatal. It takes frequently two or three years before the animal succumbs. Nasal glanders is usually not quite so slow in its progress; still it also very often takes half a year or longer before the morbid process makes sufficient headway to produce plain, unmistakable symptoms, or before the chancrous ulcers, characteristic of glanders, make their appearance in the mucous membrane of the septum of the nose. Farcy, or external glanders, is usually the least chronic (comes the soonest to a termination) of the various (uncombined) forms of glanders. Plain and unmistakable symptoms (veritable farcy-ulcers) make their appearance almost always within three months and frequently within a week or two after the infection has taken place. In mules and asses, however, the various forms of glanders are usually less chronic, make a more rapid progress, are more destructive, and come sooner to a termination than in horses. The progress of the morbid process depends also to a great extent upon the constitution and the organization of the animal and the mode and manner in which it is kept. Weather and temperature, too, have considerable influence; warm and dry weather usually retards, and cold, wet, and stormy or inclement weather usually accelerates and spreads the morbid process. Most authors discriminate between acute and a chronic form of glanders. From a practical standpoint such a distinction is perfectly admissible, but to separate acute and chronic glanders as two different diseases, as has been done by some (French) authors, must lead, and has led, to very dangerous mistakes and to great confusion. Every form of glanders, as I have said before, is naturally—*eo ipso*—more or less chronic in its course, but may become acute, either from the first beginning or at any stage of its development, and sometimes very suddenly, under any of the following conditions:

1. If a complication takes place either with one of the other forms of glanders or with another disease or disorder. Sometimes even a small

wound is sufficient to inaugurate the acute course or a rapid progress of the morbid process.

2. If glanders has been communicated by a direct introduction of glanders-matter into a wound, or a direct contact of the contagion with the blood. The greater the quantity of glanders-matter introduced the more concentrated the contagion inoculated, or the larger the wound the more acute or rapidly progressing and spreading is usually the morbid process of the communicated disease.

3. If the constitution of the animal has been weakened, or if the vitality of its organism has been seriously impaired either by glanders itself or by any other disease, the course of glanders, although naturally slow or chronic from the beginning, is usually changed to an acute one as soon as the morbid changes have become sufficiently important and extensive to weaken essentially the constitution of the animal, and to cause a profuse infection or spreading of the contagion through the lymphatics in the animal organism. Toward its fatal termination glanders, therefore, always changes its course from chronic to acute. Unlike most other diseases it commences chronic and ends acute.

4. Exposure to wet, cold, and inclement weather, catching cold, hard work, close, dirty, and ill-ventilated stables, unhealthy food, &c.—in short, everything that is calculated to produce an injurious influence upon the organism, or is calculated to impair the health of the animal, has a tendency to accelerate the morbid process, to change the chronic course of glanders to an acute one, and to hasten the outbreak after an infection has taken place.

The morbid process of glanders is accelerated and caused to spread more rapidly if the latter becomes complicated with an inflammation, or with any very feverish or very typhoid disease. The morbid processes of glanders and inflammation increase each other reciprocally. The inflammatory process adopts, to a great extent, the nature and characteristics of glanders, and the morbid process of the latter disease becomes blended with the former, and assumes the attributes of an inflammation. In either case all the symptoms become very violent, and the morbid process progresses and spreads very rapidly, particularly in those tissues which are in a state of inflammation. Ulceration, too, becomes extensive in a short time, and the lymphatics, by absorbing the deleterious matter, seem to spread the contagion and the elements of glanders rapidly through the whole system. If the original disease is glanders, farcy will also make its appearance within a short time; and *vice versa*, existing farcy will soon be complicated with nasal and pulmonal glanders of an inflammatory character. The exudations produced by an inflammation which has assumed the nature of glanders are always very deleterious and corrosive and destroy like a caustic the tissues with which they come in contact. The morbid changes effected by such an inflammation resemble those of a malignant diphtheria. In extreme cases the morbid process may become so violent as to cause the neoplastic process, characteristic of glanders, to be superseded by immediate destruction and mortification. In such a case profuse, diphtheritic ulceration and destruction of tissue take the place of the neoplastic production of glanders-cells and their subsequent decay. The glanders-cells are destroyed (decay or perish) before their formation has been completed, consequently are absent.

That a direct and abundant introduction of glanders-matter into a wound, or a direct contact of the contagion with the blood, is well calculated to produce an acute form of glanders, or sufficient to inaugurate a rapid progress of the morbid process, is probably best illustrated by a

case which occurred about eleven years ago, near Dixon, Lee county, Illinois, where I was then practicing. A farmer, Mr. B., came to my office with a horse which he had recently bought, and which was apparently suffering from some pulmonal disorder. The animal was in a moderately good condition and free from fever. The morbid symptoms observed consisted in a slightly laborious breathing, a short, dull, but somewhat loose (not dry) cough, some discharge from one nostril, and a slight swelling of the submaxillary lymphatic glands of the same side of the head. The symptoms, consequently, were the same as are usually observed in pulmonal glanders; but as none of them were sufficiently developed or presented sufficiently characteristic properties to indicate with certainty the presence of glanders, and as no ulcers—the most important diagnostic symptom of glanders—could be discovered in the nose, I hesitated to make a definite diagnosis, but informed the owner of my suspicion, and advised him to put the horse, if convenient, to hard work for the purpose of accelerating thereby the morbid process (if glanders), and to return the animal for further examination within a week or so. A few days afterwards the same farmer came again to my office with another horse with a badly torn eyelid and an inflamed eye for treatment. This latter horse, which I will call horse No. 2, had been bitten in the eyelid and had the same torn by the horse with the suspicious symptoms, which I had seen before, and which I will call horse No. 1. In examining the wound, which probably had been made during the night, I found the borders very much swelled, and the wound and the conjunctiva of the eye in a condition which strengthened my suspicions of horse No. 1 being affected with glanders. Still, by means of a few stitches, I united the margins of the wound as well as circumstances permitted. After I had performed the operation I examined the horse as to his general health, but especially as to symptoms of glanders. With the exception of some feverish acceleration of the pulse and the very inflamed condition of the torn eyelid and the conjunctiva, no morbid symptoms could be found. The horse appeared to be in good health and free from any respiratory disorder. The next day I saw both horses, Nos. 2 and 1, on B.'s farm, a few miles from Dixon. Horse No. 2 had high fever; the wound in the eyelid presented considerable swelling and had suppurated; some of the stitches had been torn out; and a lump of grayish and glassy mucus had accumulated in the inner corner or canthus of the eye. These symptoms, though comparatively insignificant under other circumstances, convinced me still more that the torn eyelid would not heal and that horse No. 1 was affected with glanders, and had communicated the contagion to horse No. 2. In the condition of horse No. 1 no essential changes had taken place, except perhaps a slight increase in the discharges from the nose. About a week later horse No. 2 presented plain and unmistakable symptoms of glanders, consisting of lameness, swelling of the inguinal glands, copious discharges from the nose, swelling of the submaxillary glands, and diphtheritic ulceration on the septum. The condition of horse No. 1 was almost unchanged. Both horses were killed the next day. The *post mortem* examination of horse No. 1 revealed, besides the characteristic morbid changes in the lungs, indicative of pulmonal glanders of long standing, only a few small ulcers high up on the septum, while horse No. 2 showed all the essential symptoms of fully-developed acute nasal glanders and of incipient farcy, but scarcely any morbid changes in the lungs. Whether the inoculation with glanders-contagion effected by the biting and tearing of the eyelid constituted the first communication of the contagion to horse No. 2 by horse No. 1, or whether a previous in-

fection had taken place (both horses had been worked together, and had been kept in the same stable a week or two before the eyelid was torn), I was unable to decide, but hold myself convinced that the direct introduction of a comparatively large quantity of the contagion into a fresh wound, and the immediate contact of the same with the blood, constituted the cause of the acute course of the disease, inaugurated by the inflammation in the wound of the eyelid. There can be no doubt of the disease having been communicated by horse No. 1 to horse No. 2, because subsequent inquiries elicited the fact that horse No. 1 had become infected with glanders several months before he came into the possession of Mr. B., by another horse to which the disease had been communicated by a condemned United States Army horse affected with glanders and sold by the government to a farmer, in whose possession he died.

Another case, perhaps not less illustrative, occurred in the same year, also not far from Dixon. I was called upon to examine a mule which showed suspicious symptoms, indicating the presence of glanders, but as no ulcers could be discovered in the nose a definite diagnosis could not be made. This, however, was the more necessary and desirable, as the mule in question had come from another State (Indiana), and had been bought only a few days before. To get out of the difficulty and to force a decision, I inoculated the mule with his own nasal discharges under the sternum behind the fore legs. In a few days a nice farcy-ulcer had developed, the symptoms of glanders proper, too, had made considerable progress, and the chronic course of the disease had been changed to an acute one.

Wherever glanders presents itself as an acute disease, either an uncommonly large quantity of the contagion has been introduced at once and brought in direct contact with the blood, or a complication of some sort has been effected.

The nature of glanders.—The hypothesis in regard to the nature of glanders, and the theories concerning the morbid changes and their relative importance, have differed very widely, and have recently undergone great changes. Although modern investigations have proved beyond a reasonable doubt that all the old hypotheses are erroneous, some of them seem yet to have their adherents.

At the end of the last and the beginning of this present century most veterinarians looked upon glanders as a blood disease. Bourgelat (1779), Kersting (1784), and Coleman (1839), supposed that glanders proceeds from a morbid, corrupt, or defective composition of the blood and looked upon that as the immediate cause of the disease.

Later veterinarians advanced different opinions. Dupuy (1849) called glanders an *affection tuberculeuse*, considered it, together with strangles or distemper, grease-heal, &c., as a tuberculous disease, and denied, like most French veterinarians, the existence of a contagion. Marel (1825) looked upon glanders as the natural consequence of a chronic inflammation of the nasal mucous membranes. Dance and Cruveilhier connected glanders with an inflammation of the lymphatics. Loiset found thrombosis in the lymphatics of the mucous membrane of the nose, and after that a tendency prevailed to consider glanders as a pyæmic disease. This new doctrine culminated in the hypothesis of Tessier, who denied the absorption of matter, substituted a formation of matter (pus) in the blood, and pronounced glanders as one of many diseases in which a tendency to produce matter is primarily existing in the blood. Finally clinical observations were made in France which removed (?) every doubt as to the pyæmic nature of glanders. Renault (*Recueil de méd. vétér.*, 1835, p. 396) published observations, according to which glanders

proceeded from a fistule on the withers, from bruising of the upper eyelid, and from a fistule of the spermatic cord. Dupuy (*Bulletin de l'Académie de méd.*, 1836, p. 481) observed that glanders proceeded from a seton on the shoulder. Riss (*Recueil de méd. vétér.*, 1837, p. 602) observed several cases of glanders which were caused by severe contusions of the nose. Rey observed that glanders made its appearance after a fracture of the nasal and maxillary bones. Afterwards Renault and Bouley (*Recueil de méd. vétér.*, 1840, p. 257) endeavored to corroborate or to affirm these observations by direct experiments. They injected matter into the veins of horses, and claimed to have produced glanders-ulcers in the nose of a horse by such an injection of innocent matter. Rey (*Recueil de méd. vétér.*, 1867, p. 417) looks upon the experiment of Renault and Bouley as a singular case, but Professor Hering in Stuttgart (*Repertorium*, 1868, p. 36) does not find it singular at all, and says that he made the same experiments a long time ago, and had succeeded in producing in some cases glanders, in other cases suppuration (in the lungs), and in others no result whatever. Such statements are, to say the least, exceedingly queer, particularly if made by such a learned and experienced man and otherwise so reliable an authority as Professor Hering, because such observations are, and must be, based upon a mistake either one way or another. There are three possibilities: Either the matter injected into the veins must have been taken from a horse affected with glanders or farcy, the animals experimented on must have been previously infected with the disease, or exposed in some way to the contagion, or the disease produced was no glanders at all. A previous infection must be considered as the most probable solution, because the horses subjected to such experiments are usually old or condemned animals bought for anatomical purposes at from two to four dollars a head. A great many experiments with injections of matter (pus) into the veins of horses—probably the most that ever have been undertaken—have been made at about the same time, but independently and at different places, by Professor Guenther in Hanover (*Nebel u. Vix Zeitschrift*, 2. B.) and Professor Spinola in Berlin (*Ueber das Vorkommen der Eiterknoten in den Lungen*, 1839). The same were afterwards repeated at various times by Professor Gerlach, the late director of the Royal Veterinary School in Berlin, who died in 1877. Neither of these three very reliable investigators nor anybody else, except Bouley and Hering, has ever succeeded in producing (?) glanders in a horse by an injection of innocent matter (pus) into the veins.

All those hypotheses and theories, notwithstanding some of them were only short-lived, contributed a great deal in creating the confusion in regard to the contagiousness or non-contagiousness of glanders (*la morve*), which, until recently, has been prevailing among the French veterinarians. Bouley separated acute glanders and chronic glanders as two distinct or entirely different diseases, and considered chronic glanders as non-contagious, and acute glanders and farcy as contagious and pyæmic diseases. Godine (*Elémens d'Hygiène vétérinaire, suivis de recherches sur la morve, etc.*, 1815), went still further, and denied the contagiousness of glanders altogether. Bouley, however, finally admitted that contagious acute glanders might, under certain circumstances, be developed from non-contagious chronic glanders. These fallacious doctrines of the professors of the Alfort veterinary school, not only caused great confusion in regard to diagnosis (glanders not being considered as a disease *sui generis*, was frequently confounded with other diseases), but also great losses, amounting to millions of dollars, to the people of France, by preventing a strict condemnation of glandered horses, and allowing thereby an unlimited spreading of the disease.

The veterinarians of Belgium, too, became infected with the French or rather Alfort confusion, otherwise they never would have stated in their official reports (*Bulletin du conseil supérieur d'agriculture du royaume de Belgique Arme*, 1858, Bruxelles, 1860), that of 810 glandered horses, 136 had been cured. The veterinary school of Lyons, France, has always kept aloof from the errors of the Alfort institution in regard to glanders, and has never denied the contagiousness of that disease.

The German veterinarians, though differing at times considerably in opinion as to the nature of glanders, have never doubted its contagiousness; and German governments have always been very strict in taking the most effective measures against the spreading of that terrible enemy of the equine race by requiring a prompt destruction of every horse reported by a veterinary surgeon as being affected with the disease. As a consequence, glanders has become a rare disease in Germany, and the annual losses are very insignificant.

Most of the older German veterinarians looked upon glanders as a dyscratic disease. Some believed they had found the immediate cause in a qualitative change of the animal albumen; others, in a morbid increase of fibrin. As to the morbid changes, some thought they had discovered something characteristic in a stagnation of lymph in the lymphatics, others in a formation of tubercles, and still others considered glanders as a product of scrofulosis. A few went even so far as to hold glanders to be identical with tuberculosis and scrofulosis. The tuberculosis doctrine originated in France, and gained a good many adherents willing to look upon glanders as an equine tuberculosis. The scrofulosis doctrine was based upon the erroneous supposition that glanders proceeds or develops from strangles or distemper, and that the latter is a scrofulous disease. Erdt (in his *Rotzdyscrasie und ihre verwandten Krankheiten*) declared glanders, as recently as 1863, to be a dyscratic disease, and discriminated a scrofulosis, blennorrhœic, septicamic, carcinomatous, syphylitic, and other forms of glanders, but considered scrofulosis glanders as the generic form. Professor Gerlach, in his valuable treatise from which several of the notes just given have been taken, refutes the theories of Erdt by the following statement, for the correctness of which I can vouch from my own knowledge of the facts:

> The breed of the milk-white (white-born) horses of the royal stables of the late Kings of Hanover was kept pure by continuous in-and-in breeding. As a consequence more than half of the number of colts born perished every year of scrofulous diseases. At the *post-mortem* examinations the mesenterial glands presented every stage of scrofulosis from simple swelling to a cheesy degeneration. Still, never a case of glanders occurred, neither among the colts nor among the grown horses. This proves that scrofulosis really makes its appearance in colts in exactly the same form as in children, and it is therefore not justifiable to attribute an entirely different disease of horses to scrofulosis.

For our present better knowledge of the nature and the morbid anatomy of glanders we are indebted especially to the thorough, unbiased, and scientific researches and investigations of Professors Virchow (*Handbuch der speciellen Pathologie*, Bd. 2, and *Die krankhaften Geschwuelste*, Bd. 2); Leisering (*Bericht ueber das Veterinairwesen im Koenigreich Sachsen*, 1862 *und* 1867); Ravitsch (*Virchow's Archiv*, Bd. 23); Roloff, (*Magazin von Gurlt und Hertwig* Bd. 30), and Gerlach (*Jahresbericht der Koenigl. Thierarzneischule zu Hannover*, 1868).

THE MORBID PROCESS.

Glanders commences as a neoplastic process—new morbid formations (glanders-cells) are produced. The mucous membrane of the respira-

tory passage, the lungs, the subcutaneous tissue and the cutis, and, occasionally, some of the connective tissues of other parts of the body, constitute the primary seat of the morbid changes. The lymphatic vessels and glands become secondarily affected. The neoplastic process, however, does not in every case of glanders occur in all those tissues named; its seat in a certain tissue determines the form of the disease. In common or nasal glanders the morbid changes have their main seat in the mucous membrane of the nasal cavities, and of the maxillary sinuses; in pulmonal glanders the same make their appearance principally in the lungs; and in farcy the neoplastic process is taking place either in the subcutaneous connective tissue (common farcy), or in the cutis itself (skin-farcy). In other tissues, morbid changes, as a general rule, occur only if glanders has become complicated with another disease—an inflammatory process, for instance. The products of the neoplastic process consist of round cells, and of spindle-shaped cells. The latter, usually, undergo further changes; some of them develop to round cells, and others serve as the elements of excessive or morbid growths of connective tissue, which, however, do not present anything characteristic, and must be considered as subordinate products of the neoplastic process. The round cells are in shape and form similar to granulation-cells and matter-corpuscles, but vary in size from that of the latter to two, three, four, five, and in some cases even ten times as large. The youngest round-cells, or those latest produced, present rather delicate outlines, and are the smallest; the oldest ones, which are distinguished by their granulated contents and their dark color, are the largest, and sometimes very large. All have large nuclei, which grow in the same proportion as the cells, and present in the older ones a dark, granulated appearance. (Fig. I, No. 4, and Fig. III, No. 6.)

The formation of these cells constitutes the real formation of all the morbid changes in glanders, and may, therefore, be considered as something characteristic of the disease, and the cells themselves are appropriately designated as glander-cells. These glander-cells have two different sources; they proceed from connective-tissue corpuscles, and also from epithelium-cells.

1. *Development of glanders-cells from connective-tissue corpuscles.*—The latter become proliferous and swell; the nucleus of each cell or corpuscle grows larger; a second and a third nucleus are produced within the walls of the cell, but not by a division of the first one. The other contents of the cell gradually granulate, the appendages or extensions drop off; finally the whole body of the cell decays. The nuclei become free; the nucleus-envelope or membrane expands, and becomes distinct from the interior, and the metamorphosis of a nucleus into a nucleated cell is thus completed. Such a new cell presents at first a very delicate contour and a large and bright nucleus, but, under favorable circumstances, will soon become firmer and grow larger. Under unfavorable conditions no further development will take place. (Fig. I, Nos. 1 and 4.)

2. *Development of glanders-cells from epithelium-cells.*—A process of proliferation makes its appearance in the tesselated and cylindrical epithelium-cells, is plainest, however, in the latter. At first the oval nucleus increases in size; then a second, and finally a third nucleus are formed at a little distance from the upper obtuse end of the first, which is not divided. The formation and growth of these nuclei cause the cylindrical cell to increase in size, or to swell, and to change its original shape till it is transformed to a mere bag filled with nuclei and small round cells. Finally the bag or the old cell-membrane decays and breaks, and the nuclei and young cells are liberated. (Fig. III, Nos. 1

and 4.) Such a production or development of glanders-cells just described can take place in young or undeveloped and incipient epithelium-cells, because round giant-cells filled with nuclei and small round cells are formed frequently in the deeper or youngest strata of the epithelium. (Fig. III, No. 5.)

Wherever such a neoplastic growth is making its appearance the process is always essentially the same. The original nuclei of the primary epithelium-cells and connective tissue-corpuscles increase in size, and new nuclei are formed within the external membrane, or envelope, of the primary cells. These nuclei are transformed into small round cells, which are liberated by the decay of the old mother or brood-cells, and constitute what is called daughter-cells, and grow larger. This growth and development constitutes a characteristic peculiarity of the large round glanders-cells, which distinguishes the same from otherwise similar granulation-cells, matter-corpuscles, and tubercle-cells, because the latter, during their whole existence, remain unchanged at their first stages of development. Although young glanders-cells are small, and large ones old, the difference in size does not depend exclusively upon the age of the cells. Other growth-promoting and growth-retarding influences must be existing, because some cells grow faster than others, and some do not seem to grow at all. Under certain circumstances only small cells can be found, which are not different from common matter corpuscles, and in other cases a great many large ones, sometimes of an extraordinary size, present themselves. If the morbid process is a violent or a very rapid one, the glanders-cells are always small; rapid development and a fluid intercellular substance constitute the agencies which deprive the cells of their ability to grow, or cause them to remain small, and of a somewhat uniform size. Consequently, in all those cases in which the morbid process of glanders is blended from the beginning with more or less inflammation and exudation, the glanders-cells will be small and numerous; and as the inflammatory exudations destroy and dissolve the intercellular substance, the latter and the exudations themselves will constitute a fluid in which the glanders-cells are kept suspended. The glanders-matter thus formed does not present, under the microscope, any characteristic differences from any other matter or pus. A production of glanders-matter and of numerous small glanders-cells is common if the neoplastic process has its seat in the subcutaneous and intermuscular connective tissues consequent in farcy. In all those cases, however, in which glanders presents itself as a chronic disease, free from any complications with inflammatory processes, &c., whatever, in which the formation of the glanders-cells is a gradual and slow one, and in which the intercellular substance is not destroyed and dissolved, the glanders-cells will grow to a certain size, and young cells with delicate contours and large, bright nuclei, older and larger ones, and very large ones with dark-colored nuclei and granulated contents, will present themselves.

The vitality of the neoplastic products of glanders is limited, but differs considerably according to circumstances. The small, rapidly produced, and therefore numerous, cells, suspended in a dissolved intercellular tissue and exudations, are similar in every respect to matter-corpuscles; the same not only do not grow, but shrink and decay very soon. If the intercellular substance does not decay, but retains its original connective properties, the glanders-cells not only grow larger, but also a great deal older, than matter-corpuscles or tubercle-cells. This vitality will be the greater the larger the space or the greater the amount of the connective intercellular substance between the single cells. Their

age, however, probably never exceeds a year or several months, notwithstanding that some glanders-nodules, tubercles, and tumors may exist, apparently unchanged, a much longer time, because the constituents of the latter, the glanders-cells, change. Old ones decay, and new ones take their place even if the whole tubercle or tumor remains essentially as it is. It is to be supposed that such a change is taking place, because every old glanders-tubercle or tumor contains always old and new cells in different stages of development.

The retrogressive metamorphosis may be called a fatty necrobiosis. At first small granules (fat granules) make their appearance in the nuclei; the latter swell or increase in size, and grow darker; granules appear also within the cells, but outside of the nuclei; finally the envelopes or external membranes of the cells decay and fall to pieces, and a granulated detritus is left behind. Therefore, after a regressive metamorphosis has set in, the glanders-nodules or tubercles and tumors are found to contain a granulated detritus, small and large granulated cells, and free granulated nuclei, if examined under the microscope. The glanders-cells may thus perish or be destroyed without any simultaneous decay of the intercellular substance. In such a case the further changes which are going on in the tissues, in which the glanders-cells are imbedded, differ according to circumstances. If the glanders-cells are but few, and rather far apart, the granulated detritus is removed by absorption, and the morbid process comes to a termination by local healing. In other cases new glanders-cells are produced, and take the place of the old ones, and the morbid growth (tubercle or tumor) continues to exist. If the decaying glanders-cells are numerous and lodged close together, the retrogressive metamorphosis is usually attended with a morbid or excessive growth or production of intercellular connective tissue; and the absorption of the detritus in such a case is attended with, and makes room for, a somewhat extensive production of new fibrous (scar) tissue; linear and somewhat prominent, white stripes, usually uniting in a common center, corresponding to the center of the former neoplastic process, make their appearance and constitute a star-shaped, whitish scar or cicatrix. In chronic glanders such cicatrices occur very often in the mucous membrane of the septum; the hard, fibroid, and callous swellings, which are sometimes found in the mucous membrane of the nose, and the fibroid tumors which occur in the lungs, and which are easily distinguished from the more pulpy glanders-nodules and tumors, are produced in the same way.

Frequently, however, that is, in all such tubercles and tumors in which the glanders-cells are numerous and separated only by very little intercellular tissue, the decay or retrogressive metamorphosis of the glanders-cells involves and causes a simultaneous decay and destruction of the intercellular substance, and of the tissue in which the morbid products are imbedded. The continuity is destroyed, and an abscess is formed. The decay usually, though not necessarily, begins in the center of the nidus of cells, and it seems that certain external influences are able to change or to accelerate the whole process. So, for instance, a general decay, or a formation of ulcers or abscesses, does not usually take place in the mucous membrane of the maxillary cavities, but almost invariably, or, at any rate, a great deal earlier in such parts of the nasal mucous membrane, which are exposed to the current of air passing through the nose at each breath. The irritation caused by the passage of air probably constitutes the cause of the more frequent occurrence of glanders-ulcers in the mucous membrane of the septum than in any

other part of the nasal mucous membrane. If glanders has become complicated with inflammation, the whole process, as has already been mentioned, is entirely different. In farcy, too, in which the morbid changes have their seat in the loose subcutaneous connective tissue, the abscesses are formed in a somewhat different way.

The infectiousness of the neoplastic products of glanders constitutes a specific and pathognomonic attribute of the same, which excludes identification with any other otherwise similar neoplastic or morbid products. The same specific agency, or the same virus, which is instrumental in communicating the disease from one animal to another, constitutes also the cause which spreads the morbid process within the organism of the affected animal. The efficiency does not seem to be dependent upon any particular shape or form of the morbid products, but to be inherent in the material, because not only the live glanders-cells, but also the dead or decayed ones, the granulated and cheesy detritus, and the watery transudations are infectious. The immediate changes produced by a local infection within the tissue, or the creeping of the morbid process from cell to cell, can be seen only under the microscope. If the glanders-process is not complicated, that is, if no other disease is existing, the spreading of the morbid process, or the progress of the local infection, is a very slow one, but is accelerated or becomes rapid if a complication sets in. The morbid process, however, spreads not only by means of a direct infection from cell to cell, but also by means of the lymphatics, which absorb infectious elements and deposit the same in the nearest lymphatic glands. That this is the case becomes evident if an animal is inoculated with glanders-virus. The lymphatics proceeding from the inoculation wound soon commence to swell like strands or chords, and undergo not seldom ulcerous decay. The lymphatic glands, too, commence to swell to solid and painful tumors which afterwards become harder and firmer, but less painful. A morbid production of connective tissue causes the firmness of the swelling, and usually renders such a diseased gland impervious to a further passage of the contents (lymph and infectious glanders elements) of the lymphatics, and prevents, therefore, a further spreading of the infection. If, however, a lymphatic gland, thus degenerated, becomes finally itself a seat of the neoplastic glanders process, or of the production of glanders-cells, the lymphatics which pass from that gland to another one will also absorb infectious material, and cause thereby a further spreading of the infection and of the morbid process. In nasal glanders, a swelling of the submaxillary lymphatic glands (which receive directly through the lymphatic vessels the lymph from the seat of the morbid process), unattended with any affection whatever of the lymphatics beyond them, is a very frequent occurrence. Hence the spreading of the morbid process by means of the lymphatics is also usually a slow one in chronic glanders; several months may elapse before a new source of infection is formed. The spreading, however, will be a comparatively rapid one in all cases of glanders in which a complication with another destructive or acute disease, as an inflammatory process, has taken place. The morbid process is also apt to spread more rapidly through the lymphatics in common farcy, in which loose connective tissue constitutes the seat of the disease. The morbid process of glanders, therefore, is infectious; a spreading of the same is not only effected within the tissue by a propagation of the glanders-cells, but also by means of the lymphatics which absorb the virus and carry the same to the nearest lymphatic glands, where the progress of the morbid process stops, if the latter are degenerated by an excessive production of connective

tissue, but proceeds further if those glands become the seat of a neoplastic production of glanders-cells, as is usually the case in farcy, and always if glanders is complicated with inflammation. It is evident that by such a spreading of the virus and absorption of deleterious glanders-matter some infectious elements, whatever their nature may be, will finally pass into the blood, and cause in that way a general disorder, or a general dyscratic condition usually called "glanders-dyscrasy." That virus or infectious elements pass over into the blood, and pervade the whole animal organism, becomes apparent by the fact that the blood and the various animal secretions, the sweat for instance, possess contagious properties already at an early stage of the disease, or before the morbid process has spread much beyond its original seat, and are able to communicate the glanders from one animal to another. It may appear to be somewhat strange that the early infectiousness of the blood and of the various secretions does not effect a general outbreak of the glanders-process in every suitable part (mucous membranes and connective tissues) of the animal body, and that, notwithstanding the facility with which the glanders-contagion communicates the disease from one animal to another, the morbid process remains usually for a long time confined to certain parts of the organism. It is, however, not any more surprising than a healing, or a cessation of the morbid process, of other equally contagious diseases—pleuro-pneumonia of cattle for instance—while the organism is yet replete with the contagion, which, in very small quantities, is able to communicate the morbid process to other animals. The truth is, our knowledge concerning the true nature of the contagious principle of the various contagious diseases is yet too limited. If the theories of Hallier and others, based upon the discovery of micrococci, &c., in the blood and in the secretions of animals affected with contagious diseases should prove to be correct; if, in other words, those micrococci—in glanders *Malleomyces equestris*, H.—do constitute the infectious elements, and the real, immediate cause of the morbid changes, all those strange phenomena may yet find a satisfactory explanation. If, however, those micrococci should not constitute the contagion, and should not be the cause of the morbid process, but the product of the same, or if their presence should prove to be a merely accidental one, it will be difficult to reconcile those facts. Professor Gerlach, who discards those theories as unfounded, hints at an exhaustion of predisposition as affording a possible explanation.

THE ANATOMICAL CHANGES.—The morbid products of the glanders-process make their appearance usually in more or less distinctly limited nests, or in shape of nodules or tubercles and tumors, which vary considerably in size. Some of them are as small as the size of a pin's head, and are called miliary tubercles; others are larger, of the size of a pea; and still others are quite large, and constitute tumors or glanders-excrescences. Practically, therefore, a discrimination between glanders-tubercles or small nests of glanders-cells, and tumors or large ones, is admissible. The former, however, must not be looked upon as identical with genuine tubercles as occurring in tuberculosis. A glanders-tubercle is a different thing altogether, only the name has become too convenient to be abolished. Glanders-tubercles occur—1, in the substance and in the subserous tissue of the lungs; 2, in the mucous membrane of the nasal cavities and of the maxillary sinuses, but especially in the mucous membrane of the septum; 3, in the swelled and indurated submaxillary glands; and, 4, in the cutis. Some authors have considered the presence of small miliary tubercles in the lungs as the criterion of the presence of glanders, but others have

found that glanders may exist and still no tubercles may be found in the lungs. Professor Roell, in Vienna, found miliary tubercles in only about 66 per cent. of all cases that came under his observation, and Professor Leisering, in Dresden, and Professor Gerlach, in Berlin, searched for them frequently in vain. Glanders-tubercles make their appearance in the lungs only if the morbid process, which has its principal seat usually—I would like to say, normally—in the mucous membrane of the nose, extends to the lungs; or if original nasal glanders has become complicated with pulmonal glanders, which, in the course of time, is a common occurrence. In those cases in which such a complication is existing from the beginning, or in which pulmonal glanders constitutes the primary disease and nasal glanders the complication, miliary tubercles are found in the lungs frequently within a short time after an infection has taken place, sometimes within from one to three weeks. The same are imbedded in the healthy pulmonal tissue, are surrounded by a court of turgid blood-vessels (Fig. VII, No. 1), have each a small blood-vessel of their own, are at first grayish-white and rather soft, consist of more or less uniform and rather small round cells, with nuclei, connected with each other by a delicate intercellulary tissue, and become, when older, enveloped by a fine tissue of connective fibers. The court of turgid or congested vessels around the tubercles disappears after some time, the blood-vessel which enters the tubercle becomes obliterated, and the substance of the latter, receiving no more nutriment, undergoes decay. A necrobiotic process commences, the round cells shrink, the intercellulary substance decays, and the interior of the tubercle is changed to a cheesy substance, in which finally lime-salts are deposited. The whole process is the same as that which is taking place in a true tubercle in tuberculosis, therefore every difference disappears after the retrogressive process has set in. Hence, glanders-tubercles have frequently been identified with veritable or tuberculosis tubercles, and glanders itself has, at times, been looked upon as a tuberculosis of horses, which assumes peculiar forms, different from tuberculosis of other animals; but as real common tuberculosis occurs in horses as an independent disease, the same as in other animals, as the cells of a glanders-tubercle are usually somewhat larger than those of a genuine (tuberculosis) tubercle, and as, finally, each glanders-tubercle possesses a full intercellulary substance, and has a blood-vessel of its own, either of which is wanting in the veritable (tuberculosis) tubercle, there can be no doubt as to glanders and tuberculosis of horses being entirely different diseases. Besides that, in tuberculosis of horses, the single tubercles are usually a great deal larger than the miliary tubercles of glanders, and only the smallest ones (those of the size of a pea) present some similarity to the larger glanders-tubercles. The retrogressive process does not present anything characteristic.

In the mucous membrane of the nose the glanders-tubercles or nodules are always plainest on the septum (Fig. IV, Nos. 1 and 2). They, too, vary in size from that of a pin's head to that of a pea, and project but little over the surface of the membrane, and are therefore sometimes scarcely visible. At a *post mortem* examination, however, the same can be seen and felt more plainly, because then the mucous membrane is less succulent and swelled. Either singly or in groups they are imbedded in the mucous membrane, usually in the upper layer, and are distinguished from the reddened membrane by their gray, grayish-white, or grayish-yellow color. Sometimes these tubercles, or glanders-nodules, are situated deeper, in the middle or lower layer of the mucosa, and therefore less distinctly circumscribed, and indicated only by a slight elevation

above the surface of the membrane, but not by any distinct color. On a cut, however, the same can be seen very plainly (Fig. V, *a* and *b*). The substance of the glanders-nodules in the nose is more or less soft, and consists of round cells, free nuclei, spindle-shaped cells, and a fine connective intercellular substance. The spindle-shaped cells are lodged mostly side by side; some of them, the younger ones, are rather thin, and others are swelled in the middle, and are ripe and near breaking. The nodules or glanders-tubercles present usually a gray-yellowish color, if composed principally of round cells, and their color is somewhat indistinct if spindle-shaped cells constitute the prevailing element. The retrogressive metamorphosis consists in a decaying to a fatty or cheesy substance. A real shrinking and exsiccation and a deposit of lime-salts do not occur. Glanders nodules or tubercles in the cutis are a comparatively rare occurrence in horses, but are observed very often in human beings affected with glanders. As the skin of horses is coated with hair, only the larger tubercles or nodules will be noticed; the very small ones usually escape observation till the regressive process has been completed, and has changed them to small lenticular ulcers. Otherwise the morbid changes are the same as in the mucous membrane.

Miliary tubercles, finally, can also frequently be found imbedded in the morbidly increased connective tissue of the indurated submaxillary and other lymphatic glands. On a cut the same can often be pressed out of the surrounding tissue as small knots or nodules. An exsiccation is a frequent occurrence, but a deposit of lime-salts has not yet been observed.

Glanders-tumors, or very large nests of glanders-cells, can be found fully developed only in the lungs, but are even there not as frequent as the tubercles. They have their seat usually immediately beneath the pulmonal pleura, especially toward the lower sharp border of the lungs. In some cases, however, the same are also found imbedded in the pulmonal tissue, and are then not seldom numerous. The tumors, or glanders growths, are either distinctly limited, and varying in size from that of a cherry to that of an apple, or the same are more or less diffuse. The large tumors seem to be composed of two or more smaller ones which have increased in size till they have come in contact with each other and have united. The intermediate pulmonal tissue in such a case has disappeared. Large tumors thus produced are frequently of an irregular shape. The pulmonal tissue surrounding the gray or grayish-yellow tumors is at first hyperæmic, and the outlines of the latter are more or less indistinct, but afterwards the same become more defined. On a cut these tumors present an appearance somewhat similar to bacon. In some cases the same are more or less firm and solid, like a fibroid growth, and in others of the consistency of a sarcoma. (Fig. VII, No. 2, presents the grayish-yellow cut-surface of a glanders-tumor in natural size, for the most part distinctly limited from the hyperæmic pulmonal tissue, but at one end yet encroaching upon the latter, and not yet presenting a distinct demarcation. Fig. VI, No. 3, is a smaller glanders-tumor in natural size, presenting yet visible, small, round, primary nodules and some remnants of pulmonal tissue, indicating plainly that the growth takes place, not from one but from several centers, and is not effected by peripheric apposition.) Under the microscope the constituents are found to be essentially the same as those of the smaller nodules or tubercles. The round cells, however, vary much more in size. Some are very large and distinguished by their dark and granulated nuclei. Numerous epithelial mother-cells, containing nuclei and incipient cells, spindle-shaped cells in different stages of development, some, maybe,

very much swelled or just breaking, and others decayed and discharging their granulated contents and large nuclei, and a connective intercellular substance which gives the whole tumor its continuity and a certain degree of solidity, constitute the principal components. The softer glanders-tumors, similar in consistency to a sarcoma, are composed mainly of round cells, while the firmer or more solid ones consist principally of spindle-shaped cells, and contain comparatively few round cells imbedded in the intercellular substance, which latter is here and there fibrous and solid, and thereby the cause of the greater firmness. The presence of both kinds of cells, spindle-shaped and large, round ones, proves that connective-tissue corpuscles, as well as epithelium elements, contribute to the formation of pulmonal glanders-tumors. The retrogressive metamorphosis proceeds, according to the observations of Gerlach, in two different ways. Sometimes all components of the glanders-tumor, the intercellular substance as well as the glanders-cells, undergo a process of decay which proceeds either from one center—if the tumor is a simple one—or from several centers simultaneously, if the tumor is a complicated one. In the former case the whole tumor is changed to one cavity with cheesy contents, but in the latter two or more larger or smaller cavities, corresponding to the number of the original tubercles or tumors, are produced. The contents of the same present also a cheesy appearance. Sometimes, however, the whole process is different. The round-cells decay and are absorbed, and an excessive growth or production of connective tissue is taking place. The tumor becomes harder and firmer, and assumes finally the characteristics of a fibroid growth, which contains interspersed in its tissue a few round-cells, and may not undergo any further changes for a long time. Such fibroid tumors correspond to the fibroid cicatrices which occur frequently in the mucous membrane of the septum, and are found not seldom if the morbid process has been a very slow or chronic one. If glanders is acute or complicated with other morbid processes which accelerate its progress, such hard and firm fibroid tumors or cicatrices are never formed. On the contrary, the glanders-tumors decay rapidly, often before the same have had time to assume definite shape and form.

Glanders-ulcers or abscesses are produced if the intercellular substance of the tubercles undergoes dissolution. Dissolved intercellular substance and decayed and decaying glanders-cells constitute the matter. The process is about as follows:

Farcy-ulcers in the subcutaneous connective tissue.—The development or the growth of a farcy-tumor is always attended with some local inflammation in the surrounding tissues. A violent proliferation begins in the center of the tumor, and numerous small round-cells which can scarcely be discriminated from matter-corpuscles are produced. The inflammatory process furnishes a sufficient quantity of exudation to loosen and to envelope the round-cells almost immediately after the same have been produced. Some white blood-corpuscles may become intermixed, but the same must be regarded as strangers, because a very large majority of the cells suspended in the fluid exudation are the product of the proliferous process. So it may happen that a farcy boil or tumor shows fluctuation, and contains matter within a few days, or is changed to an abscess much sooner than a common boil. The matter of a farcy-ulcer does not exhibit any distinctive difference from other pus except in so far as it possesses infectious qualities. Almost as soon as a farcy-boil has been changed to an abscess, or contains matter, the nearest subcutaneous lymphatics commence to swell to plainly visible chords or strands, and in their course not seldom new boils are formed.

which also undergo the same metamorphosis as the first one. Hence it happens very frequently that farcy boils and ulcers make their appearance in rows somewhat resembling strings of beads, which constitutes one of the characteristics of the disease. A little later the nearest lymphatic glands, too, commence to swell and to be changed to hard and more or less painful farcy-buboes. The circulation or the current of lymph in the lymphatics of such a swelled gland or glands becomes interrupted, and in consequence œdematous swellings make their appearance in the parts in which such an interruption has been effected, usually in a leg. The swelling of the lymphatics and of the lymphatic glands, the lymphatic abscesses, and the appearance of œdemata have led to mistakes; an inflammation of the lymphatics has been supposed to constitute the primary and the production of farcy-ulcers a secondary morbid process. Sometimes, it is true, it is rather difficult to find the primary boils or ulcers from which the morbid process has spread. The comparatively rapid dissemination of the glanders-virus through the lymphatics in the loose subcutaneous connective tissue explains why farcy usually spreads sooner over the whole body, and becomes fatal in much less time than either pulmonal or nasal glanders.

The products of the glanders-process, however, do not always present themselves as distinctly limited growths in form of nodules, tubercles, tumors, and boils. The morbid products in certain cases, especially in such in which an inflammatory exudation is taking place in the same parts in which the glanders-process has its seat, become diffuse, and the glanders-cells almost as soon as produced are carried off by the exudation. Gerlach discriminates two forms of diffuse glanders, viz., glanders-catarrh and diffuse production of glanders-cells in the mucous membranes.

1. *Glanders-catarrh.*—If the glanders-process makes its appearance in a mucous membrane, the first morbid changes and symptoms are always those of glanders, blended with a catarrhal affection. Consequently the first stage of nasal glanders may appropriately be called a "glanders-catarrh," and may under favorable circumstances exist almost unchanged for a long time without being attended by any other characteristic symptoms except perhaps some swelling of the submaxillary lymphatic glands (so-called nasal gleet). Afterward, in a more advanced stage of the disease, more characteristic morbid changes make their appearance, but the catarrhal discharge from the nose remains. In glanders-catarrh the secretions of the nasal mucous membrane differ only in so far from those observed in a common catarrh as they present frequently a greenish or green-yellowish color, and contain very soon epithelium-scales and small, round glanders-cells similar to matter-corpuscles. With the appearance of the epithelium *débris*, however, the somewhat characteristic greenish color usually disappears. The glanders-cells have their source in the epithelium-producing layer of the mucosa, and develop from epithelium-cells, but are carried off or washed away by the fluid exudations. Still the discharge itself, although containing glanders-cells, offers no characteristic of great diagnostic value except its infectiousness, which exists from the very beginning. The microscope reveals no essential differences, neither between the nasal discharges in glanders and in catarrh nor between farcy matter and common pus.

2. *Diffuse production of glanders-cells in the mucous membrane.*—The glanders-cells are not produced in certain limited spots or nests, but in diffusion over large parts of the mucous membrane. The latter appears swelled and loosened in its tissue, and contains larger or smaller numbers of round glanders-cells of different size. Afterwards an exuberant

morbid growth of connective tissue makes its appearance, which causes the mucous membrane to become more or less thick and callous. If the glanders-process extends to the frontal and maxillary cavities, the naturally fine mucous membrane, especially of the latter, is usually found coated with a muco-purulent secretion, and presents more or less uneven swelling and degeneration, caused by an exuberant neoplastic production of connective tissue elements. In the nasal cavity, but especially on the septum, the diffuse glanders-process penetrates not seldom the whole mucous membrane, and extends to the submucosa. Callous swellings are formed by an exuberant production of neoplastic elements of connective tissue, and within these swellings appear diffuse center-stations, or nests of round cells, which (latter) gradually undergo decay and are absorbed. Fibrous or scar-tissue, which afterwards shrinks or contracts to a scar or cicatrix, takes their place. So it may happen that scars or cicatrices make their appearance without any ulceration having preceded. These scars or cicatrices usually contain a center, from which several whitish strands of fibrous tissue, produced by the same process, are radiating in different directions. Still not every scar or cicatrix found on the mucous membrane of the septum has been produced in the same way, without any preceding ulceration. Under favorable circumstances a healing even of a glanders-ulcer will now and then be effected, but in such a case the scar left behind is usually less prominent or conspicuous, and is destitute of such long radiating strands of fibrous tissue.

Glanders-ulcers.—The same, if present, constitute the most characteristic and unmistakable morbid change of the whole morbid process, and are found usually in the mucous membrane of the septum, especially toward the nasal bones, but also in the mucous membrane of the conchæ, the nasal ducts, the larynx, and the windpipe, and, in rare cases, in the cutis. Professor Gerlach says he has found ulcers in the mucosa of the throat and windpipe only in acute glanders. I remember one of chronic glanders that occurred in 1869 in Quincy, Ill., in which, at the *post-mortem* examination, numerous ulcers presented themselves in the nasal ducts and in the mucous membrane of the larynx and windpipe, but none on the septum. In that horse the only observable symptom consisted, for a long time, in difficulty of breathing, resembling a kind of roaring when exercised. The *post-mortem* examination, made by myself, revealed glanders in a very advanced stage of development, notwithstanding that the horse, a fine black roadster, was not suspected of being affected with glanders up to within two weeks before he was killed.

Glanders-ulcers are always preceded by glanders-nodules or tubercles in the mucous membrane or skin, respectively, and are the product of a decay of the glanders-cells and a dissolution of the intercellular substance of those nodules or tubercles. The process, however, by which these ulcers are developed is not always the same, but varies somewhat according to the size and situation of the tubercles. If the latter are large, of the size of a pea, and extend deep into the mucous membrane, a depression, which soon changes to a small hole, at first not larger than a pin's head, makes its appearance in the middle of the external surface. This hole, however, soon grows larger (Fig. IV, No. 2), and constitutes within a few days an ulcer corresponding in size to that of the former tubercle (Fig. IV, No. 3). The deeper the latter extends into the mucosa or submucosa, the deeper will also be the ulcer.

If the glanders-tubercles are very small and superficial, or, as it sometimes happens, visible only as gray specks or dots, the proceeding is a little different. At first the epithelium is cast off; a small, scarcely

visible loss of substance takes place, which gives the incipient ulcer the appearance of a small erosion. In other cases the decayed, superficial part of the tubercle presents itself as a yellowish-gray mass, which remains for a short time coated with epithelium. The decaying tubercle, in such a case, has the appearance of a small pustule. In both cases, finally, small, flat, lenticular ulcers are formed, which, if numerous and close together, as frequently happens (glanders-tubercles, if very small, are usually situated close together in groups), become soon confluent, and present then one large, flat ulcer with an uneven bottom. A few days ago I had an opportunity to observe small lenticular, and one medium-sized confluent ulcer, on the right side of the septum of the nose of a former circus-horse that had been affected with glanders—had had discharges from the nose—for over eight months.

A glanders-ulcer once formed grows in depth and circumference as follows: At the bottom and on the borders of the ulcer, and also in the immediate neighborhood of the same, appear again gray specks and nodules (nests of round cells), which also undergo decay, become confluent with the ulcer, and increase thereby the size and depth of the latter. The bottom of a glanders-ulcer presents a grayish-yellow (bacon-like) appearance, marked with red blotches, and is composed mainly of round glanders-cells, the decay of which adds to the depths of the ulcer. Consequently, as after each decay new round cells make their appearance, a glanders-ulcer is not only able to work its way through the mucous membrane and its connective tissue, but also into and even through the cartilagenous septum and the osseous conchæ. This, however, takes place only in a very advanced stage of the disease, and under the influence of a complication with an inflammatory process. The bottom of a deep ulcer presents usually a dirty appearance, caused by decay or decomposition of tissue and blood (Fig. IV, No. 4). Growth of a glanders-ulcer in circumference is a very common occurrence. The process is usually a rapid one, if the ulcer is composed originally of small lenticular ulcers, so-called erosions, with corroded gray or inflamed and red borders. If two or more of such compound ulcers happen to be in close proximity of each other, the same very often become confluent in a comparatively short time, and present then one large ulcerating surface. In the cutis the ulceration process is exactly the same, and is invariably preceded by a formation of glanders-tubercles. The latter have their seat usually in the skin of the lips and nostrils, seldom in the skin of the legs and of other parts of the body. In the cutis, too, deep ulcers, and flat and lenticular ones, can be discriminated. In some cases the cutis-ulcers have a special tendency to increase in depth—if the preceding tubercles have been large—while in others a tendency to grow in circumference is prevailing. The latter is the case especially if the tubercles have been small and close together. Both kinds of ulcers, however, like those in the mucous membrane, produce abundant exudation and matter, a peculiarity by which deep glanders-ulcers situated in the skin are easily discriminated from farcy-ulcers or glanders-abscesses. Besides that, the latter are always kettle-shaped, have red and elevated borders, and are situated in the subcutaneous connective tissue, while the former have their seat in the skin.

THE CAUSES AND ORIGIN OF GLANDERS.

As to the causes and origin of glanders, opinions, especially in former times, have differed very widely. A great many veterinarians, particularly in France, and there until quite recently, either denied its conta-

giousness altogether (La Fosse, sen. and jun., Fromage Defeugre, and Dupuy barely admitted the possibility of an infection; Coleman (English), Smith (English), and Rodet considered only acute glanders as a contagious disease, as did Hutrel d'Arboval and many others), or expressed doubt as to the existence of a contagion.—Dutz. Consequently a spontaneous development or the possibility of the same was not questioned except by a few decided contagionists, such as Volpi in Italy, White in England, and, in modern times, Gerlach in Germany. Nearly all German, most of the English, and a great many French veterinarians (it is but just to mention among the latter Solleysel (1669), De Saunier (1734), Bourgelat (1765), Garsault (1770), Vitet (1783), Gohier (1813), Delwart, and Leblanc) admitted that most cases of glanders owe their origin to infection, but did not doubt the possibility of a protopathic, and even of a deutropathic development. Even at the present day an auchtochthonous and a deuteropathic development, too, are looked upon as something possible, or even self-evident and of frequent occurrence, not only by non-professional men, but also by a great many veterinarians of high standing. As causes of auchtochthonous glanders, all possible injurious agencies have been accused, the same as in all other contagious diseases, such as pleuropneumonia of cattle, for instance, which latter, as is now more generally admitted, spreads, and is caused exclusively by infection or by means of the contagion. As principal causes of glanders have been considered spoiled, decayed, and insufficient food, or food of a bad quality or unsuitable composition; dirty, crowded, and ill-ventilated stables; overwork, hardships, and exposure of any kind or description; in short, nearly everything that is calculated to have an injurious effect upon the animal organism. A great many horses in every country and in every clime are exposed to some or to all of the injurious influences just enumerated, and there is not the least doubt that these influences are well able to weaken the constitution of an animal, to produce emaciation and debility, and to cause a whole army of more or less dangerous and frequently fatal diseases, but still glanders is not any more frequent among horses thus exposed and suffering than among others, which are well kept and well treated in every respect. In every country and in every clime a larger or smaller number of horses are exposed to all those injuries mentioned, are worked to death, starved to death, suffocated to death in foul stable-air, poisoned to death with spoiled food and with impure, stagnant water, and still there are countries in which glanders is an unknown, or, at least, an exceedingly rare disease, while in other countries in which horses, on an average, are not kept any worse, or, may be, are kept much better, glanders is a very frequent disease, and causes annually great losses. As a general rule, which, however, suffers apparent exceptions as I shall show hereafter, glanders is frequent in all those countries in which a great many horses are imported, and rare in all those countries in which more horses are raised than needed, or from which horses are exported. Besides that, nobody has ever succeeded in producing glanders by merely exposing or subjecting a horse that has never been exposed to the influence of glanders-contagion to any or to all the injurious agencies and influences which have been mentioned as being accused as the causes of protopathic glanders. In the West, where I have lived and practiced during the last thirteen years, glanders, as I have been informed by reliable persons, used to be an almost unknown disease before the civil war, but has been spread by condemned army horses during and immediately after the war, and is now frequent and can be found everywhere.

Among asses and mules glanders is comparatively not as frequent a

disease as among horses, notwithstanding that the former have more predisposition, are easier and sooner infected, and succumb quicker. If a protopathic development were possible, or frequently taking place, one should suppose that it would occur especially in those animals (asses and mules) which possess the greatest predisposition, or, in which, if affected, the morbid process is always the most rapid and the most violent. Besides that, asses and mules particularly, are, as a general rule, more exposed to bad treatment and to all those calamities which have been looked upon as probable causes of glanders, than horses. That glanders is not so frequent among asses and mules as among horses, is simply due to the fact that the former are less numerous and usually less exposed to the contagion, because less used on the road and for traveling purposes, than horses. An exception, perhaps, may be made with the American army, or with any other army in which mules are extensively employed, and in them, I suppose, cases of glanders are just as frequent, and perhaps more frequent among the mules than among the horses.

In modern times, most veterinary writers, it seems, have abandoned the possibility of an autochthonous or idiopathic origin of glanders, but the deuteropathic development is yet upheld by a great many. The diseases supposed to terminate in glanders are especially strangles or distemper, influenza, catarrhal affections of the respiratory mucous membranes, and ulceration in various parts of the animal body. To enumerate all the cases recorded in the veterinary literature in which glanders is said or believed to have developed from other diseases, or been produced by an absorption of matter, would lead too far, for the same are very numerous. As to the different theories that have been advanced, I have to refer to what has been said in the first part of this treatise. To show, however, how easily mistakes may be made, I may be allowed to relate a case that occurred last summer in Chicago. Several horses, constituting the stock of a bankrupt circus, all animals in a very fine condition, were put up for keeping by the authorities in charge, in a certain livery and boarding stable. In the same stable influenza prevailed, and nearly every horse, excepting those circus-horses, became affected with influenza in its so-called catarrhal rheumatic form. Deaths did not occur, but some horses became affected severely. After the circus-horses had been in the livery-stable for several weeks they were sold by the United States marshal, and the day after the sale it was found that one of them, a fine black gelding, was affected with plainly developed nasal glanders, and had communicated the disease already to his stall-mate, which exhibited sufficient symptoms, a slight discharge from the right nostril and a characteristic swelling of the right submaxillary lymphatic gland, to warrant the diagnostication of glanders. After the discovery had been made, it leaked out that the black gelding had been "running from the nose" for over eight months. When the sale took place, some of the livery and boarding horses had not yet fully recovered from their influenza. Now, if one or more of the same should have become infected with glanders, and if the merely accidental discovery of the existence of that disease in one of the circus-horses had not been made, the cry would have been raised immediately that glanders had developed from influenza. Further comments, I think, are unnecessary. It may suffice to suggest that a great many apparent developments of glanders from other diseases may have taken place in a similar way. There also can be no doubt that a great many cases of occult glanders (so-called nasal gleet) have been looked upon and treated as distemper, catarrh, influenza, &c., and afterwards, when plain symptoms of glanders made their appearance, it was more convenient all around to suppose that glanders had pro-

ceeded from the disease first diagnosticated, than to admit a diagnostic mistake. So with farcy. It undoubtedly has happened a great many times that the first symptoms of farcy have been mistaken for an inflammation of the lymphatics, and as farcy in its further course becomes frequently complicated with glanders, it is easy to conclude that an inflammation of the lymphatics constitutes a primary disease of glanders. Under certain circumstances I admit it is rather difficult to discriminate at once an inflammation of the lymphatics and subsequent ulceration or formation of abscesses from genuine farcy, and so mistakes, undoubtedly, have occurred.

Besides all that, the diseases looked upon as the possible progenitors of glanders are similar to the latter only in regard to a few external symptoms but entirely different as far as the morbid process is concerned. They lack altogether, during their whole course, from first beginning to their final termination, the specific characteristics of glanders, and a conversion of any one of them into the latter disease must be looked upon as just as impossible as it is to change a cow to a horse, or a goat to a hog. Still, this does not exclude the possibility of an animal affected with one of those disorders, or with any other disease, becoming infected with glanders or farcy. On the contrary, a diseased condition of the respiratory mucous membranes seems to facilitate an infection, if an exposure to glanders contagion is taking place. At any rate, the morbid process of glanders is always much more violent, and makes a more rapid progress in a diseased organism, than in one that is otherwise perfectly healthy. To get at the bottom of the facts and to guard against mistakes, it will be necessary never to lose sight of the specific characteristics of the glanders process.

Notwithstanding all those cases of apparent deuteropathic development of glanders, which can be found in the veterinary literature of nearly every country, I am not afraid to say I do not believe that a case of real deuteropathic glanders, one that can stand a thorough and unbiased investigation, has ever occurred. Gerlach, in his treatise, repeatedly mentioned, says, on page 115, "A genuine development (protopathic and deuteropathic) must be considered as not proved."

Glanders, as well as pleuro-pneumonia, Russian cattle-plague, and scab and mange, will cease to exist if a propagation by means of infection is made impossible. If, for instance, within the limits of the United States all animals affected with glanders were destroyed at once, and at the same time every place where glanders-contagion may be existing were thoroughly disinfected, and if any importation of glandered horses or of the contagion were successfully prohibited or prevented, glanders would at once become extinct, and would never make its appearance again within the limits of the United States, unless imported again from other countries. It is a disease that can be eradicated.

I said before that glanders is most frequent in those countries in which numerous horses are imported from other countries. This is an undeniable fact, except in regard to those commonwealths in which good veterinary schools provide a sufficient number of thoroughly educated veterinary surgeons, and in which stringent laws enforce the immediate destruction of every animal affected with glanders, prohibit veterinary quackery, and do not allow anybody to keep or to treat a glandered animal unless he is a qualified veterinary surgeon, and gives sufficient bonds to pay possible damages.

I know very well that I shall be contradicted, but mere denials, or questions asking where glanders originally comes from, if a spontaneous development does not take place, will not do. Such questions, of

course, I cannot answer. When Gerlach first pronounced pleuro-pneumonia of cattle a pure contagion, that is, a disease propagated exclusively by means of infection, Professor Spinola asked pertly if Gerlach had imported pleuro-pneumonia from the moon, but failed utterly—and everybody else, too—to show a solitary case of an unmistakable and well-authenticated spontaneous development. If any one can show me a case of spontaneous glanders, not caused by infection, or give satisfactory and unmistakable proof that a protopathic or deuteropathic development of glanders has occurred, I will take back what I have said, but not before.

The contagion.—The contagion must be considered as the exclusive cause of glanders. When I lived in Dixon, Lee county, Illinois, from the fall of 1865 to September, 1868, I had an opportunity of observing numerous cases of glanders. A friend of mine, D. W. McKinney, dealer in horses and proprietor of a livery-stable, knew nearly every horse in the whole county, and taking special interest in those cases of glanders, assisted me in inquiring into the history of every horse affected. As a result, every case, without exception, was traced back to an infection by condemned United States army horses that had been sold to the farmers.

The contagious principle is developed during the very first stages of the disease, and even before plain symptoms have made their appearance. It exists most concentrated in the immediate products of the morbid process, but especially in the discharges from the nose, and in the contents of the glanders and farcy ulcers. It is present also in all the secretions and excretions of the affected animals, as has been proved by numerous direct experiments. Professor Gerlach, in order to ascertain if the contagion is contained not only in the fluid animal humors and excretions, and in the fluid and solid products of the morbid process, but also in the pulmonal exhalation and in the perspiration, has made several interesting experiments, and has found that an inoculation of a healthy horse with artificially condensed exhalation and perspiration of a glandered animal produces the disease. He has, however, not succeeded in communicating glanders by injecting defibrinated blood of glandered horses (100 and 200 grains respectively) into the veins of healthy animals. Still, the contagiousness of the blood has been established long ago by Abildgardt and Viborg in Copenhagen.

The experiments of Gerlach and of others, and numerous clinical observations, too, have proved beyond a doubt that the contagion contained in the exhalation and perspiration clings, though only in small quantities, to the aqueous vapors exhaled by the respiratory organs and perspired by the skin. The contagious principle, therefore, is volatile only in a limited degree, and to produce an infection by means of the exhalation and perspiration at a distance of several feet requires usually some length of time. So it happens very often that a horse occupying with a glandered horse the same stable, but not the same stall, remains exempted. The more forcible and accelerated the breathing, and the more abundant the perspiration of the horse affected with glanders, the greater, it seems, is the danger of an infection of healthy horses that are near, or occupy the same stable.

Another question not easily answered, and yet an object for investigation, may be asked; that is, Do organic forms constitute the contagion; is the contagious principle bound on, or inseparable from, organic forms; or is its action merely a chemical one? On this question the opinions of the best authorities differ. Professor Gerlach, in his successful experiments with condensed exhalation and perspiration, found no organic forms whatever in the perfectly limpid drops; further, he

found no organic forms in the very infectious caseous substances taken from the mucous membrane of a horse affected with diphtheritic glanders. He, therefore, has come to the conclusion that the glanders-contagion does not consist in, nor is bound on, organic forms, and that the action of the contagious principle must be a chemical one. On the other hand Hallier and others have found organic growth (micrococci) in the humors of glandered horses and in the products of the morbid process of glanders, and are inclined to consider those micrococci as the agency which causes the disease, produces the morbid changes, and effects a communication of the glandered process to other healthy animals. If Hallier and others are right, a great many mysterious phenomena observed in glanders find an explanation, but if Gerlach's observations are correct, Hallier's theories necessarily fall to the ground. Gerlach says: "Hallier finds everywhere fungi, and Chauveau finds everywhere cells." Still, notwithstanding my high regard for Gerlach and the thoroughness of his investigations, I think the finds of Hallier and of other investigators cannot be discarded; positive evidence is always of more value than negative proof. Haeckel (History of Creation, vol. 1, Protista.) and Klebs (*Archiv fuer experimental-Pathologie*, 1873), separate the microscopic organisms found in glanders and in other contagious diseases from the class "fungus," and consider them as a separate class, belonging neither to the animal nor to the vegetable kingdom. Whatever may be the truth as to the real nature of the contagious principle, future investigations must reveal. I myself have had no opportunity to make thorough microscopical investigations of the morbid products of glanders, and can, therefore, not advance any definite opinion of my own. Mere speculations cannot bring any facts to light; thorough and patient observations are necessary.

The glanders-contagion, whatever its nature may be, communicates glanders and farcy not only to the animals belonging to the genus equus, but also to other animals and to man. Numerous cases are reported every year in the periodical veterinary literature. The only domesticated animal that seems to be exempted, or to be destitute of any predisposition is the ox.

Glandered horses, as soon as the disease has been diagnosticated, are usually removed to the cow-stable, or to pens or places where cattle are kept, and still no case, as far as I have been able to learn, is on record in which an ox or a cow has contracted the disease. Sheep are easily infected. Goats, too, possess sufficient predisposition. Ercolani described a case in "*Il medico veterinaria*," 1861, and Wirth succeeded in communicating glanders to a male goat by means of inoculation (*Archiv fuer Thierheilkunde*, Bd. 6, Heft 1, 1844). Hogs seem to possess but little predisposition, and cases of dogs becoming infected and dying of glanders have been communicated by Nordstroem (*Tidskrift for Veterinairer*, etc., 1862) and Langeron (*Revue vétérinaire*, etc., Toulouse, série I, 1876). Several cases are on record in which wild animals, lions especially, have become infected with glanders by being fed with meat of glandered horses. According to the experiments of Viborg and Ringheim, the flesh of a horse affected with glanders can be eaten without danger of infection if properly cooked or fried.

One important phenomenon must be mentioned, and that is, that glanders always becomes a frequent disease after any great war. Such was the case in our own country after the great civil war, as I have mentioned before, and also in Germany and France, but especially in the latter country, after the war of 1870–'71. Cases of glanders will also be frequent during the next few years in the Turkish Empire, and in those

Turkish provinces which have become independent, or separated from the Ottoman territories. The cause of this frequency is an obvious one. It consists in the abundant opportunity of infection. One horse affected with (occult) glanders in either of the hostile armies can, for obvious reasons, communicate the disease with the greatest facility to a large number of animals. The fact of glanders becoming frequent after each large war has been used very frequently as an argument in favor of a protopathic development, but if it is looked upon in a proper light it proves, if anything, the exclusive spreading of the disease by means of the contagion.

Prevention and treatment.—As to a medical treatment, there is scarcely a remedy known in the whole materia medica that has not been used against glanders, but, so far at least, with very poor success. It is true a great many *pretended* cures are on record. But if the slow or chronic progress of the morbid process, its frequent remissions in warm and dry weather, exacerbations in rough, cold, and inclement weather and in a foul atmosphere, and the great confusion that has prevailed in regard to the true nature of glanders are taken into consideration, it is no wonder that mistakes and deceptions have occurred. Some of the cases that are said to have been cured have been no glanders at all, and in others the pretended cures have been only temporary—a mere remission. *Confirmed glanders must be considered as incurable;* and it would, therefore, be for the benefit of every one if our general government (Congress) would enact a law which should make it a criminal offense to keep and to use a horse, or any other animal, known to be affected with glanders. Any attempt to cure should also be strictly forbidden, because a prompt and immediate destruction of every animal affected with glanders, a disease which spreads only by means of its contagion, constitutes the best, surest, and cheapest, and in fact the only prevention.

A case of recent occurrence will serve to illustrate how glanders spreads, and how much cheaper it is to destroy a glandered horse at once than to permit the same to communicate the disease to healthy animals. It will also show the necessity of a stringent law making the sale of an animal known to be affected with a contagious disease a criminal offense.

Last fall Mr. George T. . . . . , Pottawatomie county, Kansas, bought a horse of a Mr. Ch. . . , Manhattan, Riley county, Kansas, and pastured and stabled the same with his other horses, about twenty-four or twenty-five in number. The horse in question, when bought, had some discharge from the nose, which, of course, was pronounced to be nothing but the product of catarrh—in common parlance, a cold. In the course of the winter several of Mr. T. . . . 's horses commenced to have discharges from the nose. Mr. T. . . . . became alarmed, and brought the new horse, whose nasal discharges had increased, and who showed other symptoms of disease, such as a staring coat, emaciation, &c., to me for examination. I found the symptoms to be those of an advanced stage of glanders. Subsequent inquiries revealed some of the previous history of the animal. Mr. Ch. . . had bought the horse from another man, whose name I do not remember, only a few days before he sold the same to Mr. T. . . . . , and had kept the animal, while in his possession, strictly separated from his other horses, because he knew that the same had a chronic discharge from the nose, and had had it for about two years. Is not such a transaction criminal? And still, in the case mentioned, there is no redress to be had. Mr. T. . . . . is a comparatively poor man; his farm is mortgaged, and all the property he may call his own consists in his stock, but especially in his horses. As I moved away from Kansas

early in the spring, I have not learned how many of his horses have become affected, but several had contracted the disease before I left. Besides that, his horses had been together quite often with those of his neighbors, on the prairie, before he knew them to be affected with glanders. It is possible that he has lost, or will lose, nearly every animal he has. Mr. Ch. . . does not own anything; all his property is in his wife's name; consequently Mr. T. . . . . , if he sues for damages, will have to pay lawyers' fees and costs, but cannot recover anything. If there were a United States law which made it a criminal offense to sell animals affected with contagious diseases, or to own and to keep animals which exhibit symptoms of contagious diseases, and to neglect to advise the proper authorities of the fact, such cases as the one related would not occur. If Mr. T. . . . . were not an honest man, he would undoubtedly have kept still, and would have sold his glandered horses to other innocent parties, and contributed in that way in spreading the disease. I could relate numerous similar cases, but think this one will suffice, especially as this article is already too long.

A successful prevention of glanders is possible only if the contagion—which, even if it should not constitute the sole and only cause of the disease, causes at least nine hundred and ninety-nine cases of one thousand—is thoroughly destroyed wherever it may exist or wherever it may be found. Consequently every animal affected with glanders should be killed as soon as the nature of the disease becomes known, and be buried sufficiently deep or be cremated. But as the contagion adheres frequently also to the stables—manger, floor, partition, &c.—that have been occupied, the stable utensils—brush, curry-comb, &c., and the harness, blankets, halters, bridles, saddles, &c.—that have been used or been in contact with glandered horses, it is of great importance to know what will best and most effectually destroy the contagion. Professor Gerlach has made very interesting and valuable experiments, to relate which, however, would lead too far. I will therefore only state the results arrived at. The discharges from the nose, glanders-matter, &c., lose their infectiousness if perfectly dried by being exposed to currents of air or to the rays of the sun; but kept moist, for instance in a damp cellar, wrapped up in a moist rag, or adhering to the corners of the manger, to a damp wall or floor, or to the bedding or the manure, &c., the contagion seems to possess great vitality, and may remain effective for half a year or longer. Putrefaction does not destroy the contagious principle. Chlorine destroys the contagion, and is therefore a very efficient disinfectant, provided the chlorides used come in actual contact with the contagion. A brief exposure of the infectious substances, nasal discharges, glanders-matter, &c., to the influence of chlorine in a gaseous state, mixed with the atmosphere, is ineffective. As a remedy to be given internally, chlorine, in shape of chlorine-water, for obvious reasons cannot be used; chemical combinations will be effected before an absorption can take place. The best and surest destroyer of the glanders-contagion is carbolic acid. It may be used not only as a disinfectant or for the purpose of destroying the contagion clinging to the wood-work of the stable &c., but also in incipient cases of farcy, and in cases in which an infection with glanders-matter has just taken place in a wound, for instance, as a local remedy. If applied to the glanders-ulcers on the septum, or to farcy-ulcers, a tendency to heal will make its appearance. As a disinfectant, a solution of carbolic acid in glycerine or alcohol and water (1:1 or 2:20) is perfectly strong enough to be effective. Old straw, hay, and bedding must be burned, and blankets, &c., are best disinfected

by exposing the same for some time to a temperature of 212° F., or higher, either in an oven or in boiling hot water.

As to a therapeutic treatment only a few words will be necessary. Some of the most heroic medicines have been used with very doubtful results. So, for instance, Professor Ercolani, in Turin, claims to have had good success with arsenate of strychnine, but others who have made the same experiments have had no success whatever. Lacaze (*Revue Vétér., &c.*, Toulouse, 1876), asserts to have been successful with large doses of alcohol, but he discriminates contagious and noncontagious glanders, and so no comment will be necessary. In former times cantharides were considered as a remedy, but later investigations have proved them to be perfectly worthless. That every kind of mercurial combination and a great many sure-cure nostrums have been used and been advertised as specific remedies, as in every other incurable disease, is too self-evident to need any further mentioning.

The only rational treatment of a horse or other animal, affected with glanders, consists in a proper and effective application, in the right place, of either half an ounce of lead or five inches of steel; and until such treatment is invariably adopted, or made compulsory, there will be no prospect whatever of freeing this country from this loathsome disease, dangerous even to man, in whom, if once infected, it is just as incurable as in horses.

THE AGRICULTURE AND SOILS OF CALIFORNIA.

By E. W. Hilgard.

Agriculture in California possesses many peculiarities, arising partly from climatic causes, and partly from the somewhat exceptional history of the industrial development of the State. From the condition of total neglect in which it was left during the prevalence of the mining fever, it has, in the course of a few years, risen to be the commanding industry of the State. But unlike the great agricultural States of the Mississippi Valley, California has not undergone the slow and regular process of settlement by pioneer farmers, who, fleeing from the too close approach of towns and neighbors, as well as from soil exhaustion, keep selling out and moving west as part of their normal existence. The great tide-wave of the rush for gold cast a far different material on the shores of the Pacific; and when the placer mines ceased to yield fortunes to the men of small means, and agriculture began to attract their attention as a surer mode of acquiring the coveted metal, very many of the hands that grasped the plow had never felt its touch before, while their owners would have been at a loss to distinguish a grain-field from a meadow; but among these, as well as among those who at that time returned to the plow after a few years' digression, there was an unusual proportion of progressive, thinking, and reading men, whose ambition and energy had carried them forward when others fainted by the wayside. Both classes of men soon discovered that in a great many respects the rule-of-thumb experience and practice of the older countries would not avail them here; and casting loose from precedent, they tried a "new deal" in constructing for themselves a practice adapted to the new conditions. One of the controlling features being the scarcity and high price of labor, the introduction of labor-saving machinery was among the very first needs, instead of being a late fruit of long discussion and costly experience. Inasmuch as all such implements had to

be brought from the East at great expense, it was the obvious policy to bring only the best. But many even of these were soon found to be behind the requirements of California progressiveness, and home invention and manufacture soon set to work, hand in hand, for still farther improvements. The great Moline plow and the sulky cultivator of the Western States were combined into the gang-plow, and the self-binding reaper was rendered superfluous by the gigantic header, which dispenses with both binding and stacking. Finally, to save time and handling still farther, we are threatened with a combination of the header and thrasher, whereby the grain is almost automatically sacked, ready for shipment to Liverpool, within a minute or two of its removal from the stalk on which it grew. The steam-plow and steam-wagon, whenever their time comes, will nowhere find as warm a welcome as in California. In curious contrast to this refinement of perfected appliances stands the crude system of culture in which they are employed. In direct proportion to their efficiency they aid in robbing the soil more rapidly of the accumulated treasures of a thousand years; and soil-exhaustion progresses with long strides, leaving far behind the puny efforts of the growers of wheat and corn in the Western States, and successfully emulating the ruinous system of cotton-planting in the South. Outside of truck-gardens, vineyards, and to some extent orchards, the only means of soil improvement thus far practiced on a large scale is the summer-fallow, not even the rotation of crops being as yet recognized in any great degree as a necessary means of husbanding the resources of the soil. Nothing can in this respect be more eloquent than the fact that the two establishments in San Francisco now manufacturing bone and meat manures from the slaughter-house offal have to seek and do find a ready market for their products in New Zealand and Australia. But it is not an easy task to persuade the Californian farmer that his methods are not what they should be. Having been obliged to discard a good many of the old-country practices, his conviction that things in California are altogether different, exceptional, and without precedent, is strong and deep-seated; and certain experiences had with "experts" at the mines in olden times have left him a strong impression that not only a new practice but a new science will have to be set up to meet the case of California.

It is undoubtedly true, that suggestions for advantageous changes in time-honored practice have to be made with unusual caution by any one not thoroughly familiar with the peculiarities of a California climate and its possible unexpected developments. It is proverbial that "no two seasons are alike," and that "the oldest citizen" is apt to be more cautious in his predictions of the weather than the novice, who allows himself to be misled by his eastern experience, while neither usually comes very near the mark. It is impossible to discuss intelligently the peculiarities of agriculture in California without adverting somewhat in detail to the climatic features upon which the former depend. It is self-evident that within a coast State, stretching through ten and a half degrees of latitude (as far as from Boston to Southern Georgia), and diversified with mountain chains, local climate must vary greatly; and he who cannot find within these limits some spot to suit his tastes must be fastidious indeed. In matter of fact, the seasons in the most northerly counties of the State resemble much more nearly those of Oregon than those of Middle and Southern California in the amount and distribution of the rainfall, the governing influence which chiefly determines agricultural peculiarities everywhere. It is, therefore, mainly the southern three-fourths of the State of California I propose to consider here. Within these limits, which embrace the most populous and most generally

known portions of California, there is also, of course, a wide diversity of local climates. The salient climatic feature of the whole, however, is that practically all the water relied on for the production of crops falls between the middle of November and the first of April. The rains come from the south, often accompanied by strong but steady winds; sometimes in storms lasting but a day, more frequently three days, and sometimes, with little interruption, for two or more weeks; they are unaccompanied by lightning, and thunder is rarely heard more than once a year in Middle and Southern California. It is during this rainy period that crops are made or undone; the impetus then given to vegetation must carry it to maturity, and the kind intensity of that "start" will, in the majority of cases, determine the ultimate yield. Rains of brief duration may fall before or after the epoch mentioned, or exceptionally in any month in the year; but if so, they are looked upon with indifference at best, and mostly with well-founded apprehension of harm, since they in terfere with the plan of agricultural operations established on the average supposition that fully six months in the year will be practically rainless. When, moreover, it is understood that in a large portion of the region under consideration the average annual rainfall barely comes up to the minimum of 10 inches estimated to be necessary for the growth of a crop, while over most of the remaining portion the average does not exceed (except locally) twice and a half that minimum, it will be readily conceived that the California farmer watches the rain-gauge with the same feelings with which the Egyptian regards the nilometer; and as the latter counts his seasons by Nile-inundations, so the California farmer reckons his time by "seasons" instead of calendar years. It is of comparatively little interest to him how much rain has fallen from January to January, as exhibited in the usual form of meteorological tables; for the 40 inches of rainfall so shown as the aggregate of two consecutive years may have been so distributed as to leave him "high and dry" during one growing season, with an excess for the other.

In order to exhibit the "fat" and "lean" years of California, it is necessary to tabulate or plot the rainfall by "seasons"; and after some unsuccessful attempts to connect their recurrence with the eleven-year period of the sun-spots, a discussion of the observations of twenty-eight years now on record, Prof. G. F. Becker, of the University of California, seems to show the existence of a thirteen-year period between consecutive minima, the second minimum within the time of the American occupation having occurred in the season of 1876–'77, with a rainfall of only 10 inches at San Francisco, where the average is 23½ inches; while in some portions of the upper San Joaquin Valley, as at Bakersfield, as well as in the region of the Mojave Desert, there was not rainfall enough to start vegetation at all, and no ground not irrigated was broken that season. In autumn, 1877, much of that region resembled a well-swept barn floor. There is an Indian tradition that at one time toward the end of summer water was only found in pools in the Sacramento River, so little snow having fallen the previous winter that all streams ceased to flow. From information kindly furnished me by H. H. Bancroft, esq., of San Francisco, it appears that in the records of the early explorers of California, the year 1805 is known as the "hungry year," the drought having been extraordinarily severe; and nearly the same account is given of the year 1817. It will be observed that these dates indicate a period of twelve years between themselves, and that the interval from the latter date to 1877—for those drought-years as yet no data have been found—is also divisible by the same number. It is quite intelligible that as the result of several concurrent causes the period may vary between such limits as twelve and thirteen.

It has been suggested that a study of the growth-rings of the ancient Redwoods and Sequoias might lead to the recognition of the laws governing the seasons through past ages; it being probable that the dry years would be represented by a smaller growth than the wet ones. Unfortunately, it appears that in California, as well as in other countries where there is no well-defined season of rest for vegetation, the formation of several growth-rings within the year is of frequent occurrence, so that even the estimate of the age of the great trees is thereby materially vitiated. I have seen on the face of a redwood plank, 8 feet wide, groups of three, seven, twelve, and even thirty closely contiguous rings, occupying spaces but little larger than the intervals between two rings elsewhere, making it appear clearly that the unraveling of their record requires more than mere counting and measuring. But whatever may be the precise period in general, the fact that the average rainfall in so many regions nearly approaches the minimum required for any crop, gives exceptional importance to the minor, or annual, as well as local variations of its amount and distribution. It thus happens that in each region experience has shown a certain average expectation of successes and failures of unirrigated crops, which is taken into account by the farmer in his calculations. It is not, of course, easy to obtain perfectly impartial figures in this regard, the more as each valley may differ from its neighbor, and differences of crops, cultivation, and soil come in for a large share of influence. Besides, the shortness of the rainfall during one "season" may be materially supplemented, and fair crops made, when the preceding season has been one of abundant rain, it being popularly said that there is a chance for a crop whenever the moisture rising from below and that coming from above have met. This naturally happens much sooner in land kept tilled than in such as has been left to crack open—given free access to the hot, dry air of summer. In such soil, in the San Joaquin Plains, no perceptible moisture is to be found at depths of three, and even four, feet at the end of the dry season, while in deeply tilled land it may be reached at 12 or 15 inches. Again, a slow and gentle falling of a small amount of water will do as much good as a larger amount falling violently and largely draining into the streams; while, on the other hand, a few days' prevalence of a dry "norther" may completely wipe out the effect of spring showers that otherwise would have turned the scale in favor of the producer.

For the middle San Joaquin Valley, with from 9 to 10 inches of average rainfall, the usual estimate for cereals is that about two full crops out of five will be made without irrigation, the proportion increasing toward the north and decreasing toward the south, until in the Mojave Desert, with only about 3 inches of rain, the chances of making a crop without irrigation are too remote to be considered. Since, however, the rainfall increases pretty regularly with the elevation, the slopes and valleys of the foot-hills of the Sierra will frequently bear crops when there is failure in the valley. On the seaward slope of the coast range, where the rainfall is considerably greater than at a corresponding height and latitude in the interior, the average proportion of successes to failures varies greatly with locality and soil. The summer fogs brought in regularly by the trade-winds, as well as the coolness of that season, serve to eke out largely a scanty rainfall wherever the coast winds have access. Thus Santa Barbara, with about 12 inches of rain, only claims at least two crops out of three. The country bordering on the Bay of San Francisco, six out of seven or eight, each of the tributary valleys differing in this respect; and one, that of Napa, with 30 to 34 inches on an average, claims that crops never fail for want of sufficient moisture.

IRRIGATION.

It will thus be readily understood that it is difficult to overestimate the importance of artificial irrigation in the middle and southern parts of California. In the entire valley of the San Joaquin it is the condition-precedent of assured success in farming; which otherwise is nearly as full of risks as speculation in mining stocks, and to many has proved equally seductive and fatal; for in favorable seasons, the cereal crops of that region are prodigious, and successes therein have made many fortunes, which too often have again vanished into thin air on a repetition of the venture. The bordering mountains supply water enough for the irrigation of the whole region, at least so long as the forests on the Sierras shall be preserved; and where this supply has been made available, as in a number of the "irrigated colonies" of Fresno, Los Angeles, and other counties, the results have been most satisfactory in every point of view. Not only does the irrigated land produce certain and large crops, but also several such in a single season, if so desired. The land is thus rendered very valuable, is naturally divided into small parcels, and thus invites and favors a system of conservative and intense culture, which is the exact reverse of the general practice of American farmers, and cannot fail to exert a beneficial influence in improving the latter by the example of success thus set.

At the head of the Great Valley, in the tributary valleys on its east side, and in the comparatively narrow strip of land lying between the rivers and the Sierra, irrigating ditches are rapidly multiplying, though unfortunately, so far, not generally upon any comprehensive plan. In the vast and, when watered, profusely fertile plains on the west side but little has been done as yet toward irrigation, the cost of bringing water being too great for either a private purse or even for that of a corporation; for the small streams of the coast range can only be locally utilized. The projected great "West-side Irrigation Canal," which is to be fed by the headwaters of the San Joaquin, is now the subject of extensive surveys ordered by the State, and when constructed will, it is expected, redeem the whole of the valley from its scourge of drought and render it the garden of California. At many points, both in the valley and on the coastward slope, artesian wells have been successfully resorted to as sources of water for irrigation, even on a large scale.

THE CLIMATES.

Taking as a convenient point of view the central portion of the State, the climates of California may, for agricultural purposes, be roughly classified as follows:

1. *The bay and coast climate.*—Its prominent characteristics are, first, the small range of the thermometer, caused by the tempering influence of the sea, the prevailing winds being from the west. The average winter and summer temperature at San Francisco thus differs by only about 5° Fahrenheit (50° and 51° respectively). Snow rarely reaches the level of the sea, and is sometimes not seen for several seasons even on the summits of the Coast Range. A few light frosts, with the thermometer at between 28° and 32° Fahrenheit for a few hours during the night, is the ordinary expectation for winter, while in summer the number of "hot" days on which the thermometer reaches 80° or more rarely exceeds eight or ten. These occur chiefly in September, and under the influence of the "norther," which causes the hot, dry air of the interior valleys to overflow the barrier of the Coast Range. Under a brilliantly

clear sky, it sweeps over the mountains, accompanied by clouds of dust, and, like the hot breath of a furnace, it licks up all moisture before it, wilting and withering the leaves of all but the most hardy plants, cracking and baking the soil, loosening the joints of all wooden structures, whether wagons, furniture, or houses, and causing the latter to resound at night with the splitting of panels and similar unearthly noises, to the discomfort of the nervous sleepers, that at such times comprise the vast majority of the population. This universal infliction fortunately lasts but rarely more than three days, when the welcome sea-fog, which has been kept standing like a wall forty or fifty miles in the offing, gradually advances, and with its grateful coolness and moisture infuses fresh life into the parched vegetation and the irritable, panting population.

During the winter months the north wind is equally dry, but at the same time cold; and while it then sometimes lasts a week or more, it causes but little discomfort or damage, save occasionally to the young grass and grain. The second distinctive feature of the coast climate is the fogs brought in from the sea by the prevailing west winds or summer trades, as the result of their crossing the cold Alaskan current inshore. The sea-fogs, coming in regularly almost every afternoon from the latter part of June to that of August, and more or less throughout the year, often with a gorgeous display of cloud pictures, temper materially not only the heat, but also the summer drought; so that under their influence plants requiring but a moderate degree of moisture can, in a loose soil, grow throughout that season. In the latitude of San Francisco it thus happens that in the coast climate sub-tropical and northern plants may thrive side by side; the latter (such as currants and cranberries) ripening with ease and in great perfection, while the fig, grape, orange, &c., though growing luxuriantly, can ripen their fruit only in valleys protected by mountain ridges from the direct influence of the summer trade-winds. Thus while a broad river of fog may be pouring in at the Golden Gate, covering the two cities and spreading out on the opposite shore to a width of eight or ten miles, the hamlet of San Rafael, only fourteen miles to the north, but under the lee of Mount Tamalpais, and the old town of San José, under the protection of its seaward mountains, forty miles to the south, are mostly basking in full sunshine, and ripen to great perfection not only the grape, but also the more tender fruits of their groves of fig and orange.

2. *Climate of the great interior valley.*—The *average* winter temperature is lower than that of corresponding portions of the coast, although the *minimum* is little, if at all, below that of the latter. Sub-tropical plants, therefore, winter there almost as readily as on the coast. In summer, however, the average temperature is high, often remaining above 100° Fahrenheit for many days, the nights also being very warm. At the same time, however, the air is so dry as to render the heat much less oppressive than is the case east of the mountains, sunstroke being almost unknown. Standing on the summits of the Coast Range in summer, and looking down upon the thick shroud of fog covering all to seaward, the white masses can be seen drifting against the mountain side, and, rising upward, dissolving into thin air as soon as, on passing the divide, they meet the warmth of the Great Valley. From points in the latter the cloud-banks may be seen filling the mountain passes and sometimes pouring like a cataract over the summit ridges, but powerless to disturb even for a moment the serenity of the summer sky, or to yield a drop of moisture to the parched soil of the San Joaquin Plains. The unwary traveler, starting from Sacramento or Stockton on a hot summer's day without the thought of shawl or overcoat, may find himself

chilled to the bone on crossing the Coast Range, and runs imminent risk of rheumatism or pneumonia. On the other hand, the San Franciscan, feeling the need of having his pores opened by a good perspiration, can have his wish gratified in an hour or two by taking the reverse direction. The "norther" is, of course, more frequent in the great valley than on the coast; but its dryness and high temperature are not so much of a change from the ordinary condition of things, and it therefore does not cause such general remark, disturbance, or damage unless unusually severe.

3. *Climate of the slope of the Sierra Nevada.*—The essential features of the climate of the Great Valley may be roughly said to extend to the height of about 2,000 feet up its flanks into the "foot-hills," with, however, an increasing rainfall as we ascend, and therefore greater safety for crops and less absolute dependence upon irrigation. Higher up, the influence of elevation makes itself felt; snow falls and lies in winter, while the summers are cool; and we thus return to the familiar *régime* of seasons as understood in the Middle and Northern States, including, especially in the more northern portion, the phenomenon of summer thunder-storms, which are almost unknown on the coast and in the San Joaquin Valley. The same general features come into play more and more as we advance northward in the hilly and mountainous regions lying north of San Francisco Bay, toward the Oregon line, marked also in general by a gradual increase of timber growth. The features of the three principal climates described intermingle, or are interspersed, according as the valleys are open to seaward, run parallel to the coast, or are in communication with the great interior valley. We thus find numberless local climates, "thermal belts," and privileged nooks adapted to special cultures which may be impracticable in an adjoining valley, and almost insular as regards the region where similar conditions are predominant. To the southward, the chief climates above defined are modified by three factors, viz: the increase of temperature, the decrease of rainfall, and the decrease, from about San Francisco southward, of the feature of summer fogs. As regards temperature, the extreme range is still very nearly the same at Los Angeles as at San Francisco; but the averages are very considerably higher at the former point, that of the winter being 60°, that of summer about 75° Fahrenheit. At intermediate points along the coast, local variations excepted, the averages vary as sensibly as the latitude. As to rainfall along the coast, its decrease is slow, descending from 24 inches at San Francisco to 15 at Santa Barbara, 12 at Los Angeles, and 9 to 10 at San Diego. But in the interior valley the decrease is much more rapid, as previously stated, modified locally, according as the divide of the Coast Range is so high as to preclude the access of moisture from the sea, or low enough to admit its influence. The same factor influences also the cooling and moistening effect of the summer winds and fogs, which temper the summer climate of the Los Angeles Plain, but fail to reach the Mojave Desert or the fervid plains of the upper San Joaquin Valley.

SOILS OF CALIFORNIA.

In a region of such vast extent, traversed by mountain ranges formed of rocks of all kinds and ages, there is of course an endless variety of soils, to describe all of which would be beyond the limits of the present article, even if the data were available. Unfortunately this is far from being the case, the geological survey having paid but little attention to the examination of soils, which, it is true, is a subject requiring special

qualifications and care on the part of the observer to insure useful results. There are, however, some general features developed on a large scale in the more thickly settled parts of the State, a brief summary of which may find a place here.

It is well known that the main axis of the Sierra Nevada is formed by granitic rocks, which in the northern portion of the range, as well as on the slopes, are usually overlaid by clay slates and shales, forming the proverbial "bed-rock" of the gold-placers and gravel-beds. The soil derived either directly from the granites or from the older portion of the slates—in other words, the gold-bearing soil of the Sierra slope—is an orange-colored (commonly called "red") loam, more or less clayey or sandy according to location, and greatly resembles, on the whole, the older portion of the "yellow loam" subsoil of the Gulf States. Of course it contains much more of coarse materials in the shape of undecomposed rock, and its sand-grains are sharp instead of rounded. It is the predominant soil of "the foot-hills," and where ridges extend from these out into the Great Valley they are usually characterized by the red tint, which gradually fades out as the ridges flatten into swales in their approach to the San Joaquin and Sacramento Rivers, being lost in the gray or black of the "adobe," or the buff of the river-sediment soils. Its admixture is everywhere, I believe, found to be advantageous to the other soils; and in the foot-hills themselves it proves to be highly productive, as well as durable, easy of tillage, and what is termed a "warm" soil. The rocks of the lower slope of the Sierra, but more especially those of the Coast Range opposite, are predominantly of a very clayey character, soft gray clay shales and laminated clays alternating with ledges of soft clay sandstone and brittle hornstone. Their mechanical and chemical decomposition results, therefore, in the formation of gray, buff, or sometimes almost white clay soils, which occupy the hillsides and higher portions of the valleys, while in the lower portions the admixture of vegetable matter, especially in the presence of a comparatively large amount of lime, causes them to appear dark, and often coal-black. These soils constitute the "adobe," so often mentioned in connection with California agriculture. They are substantially the same, both as to tilling qualities and chemical composition, as the prairie soils of the Western and Southern States. Like these, they are rich in plant food, durable, and strong, yielding the highest returns of field crops in favorable seasons and under good culture, but sensitive to extremes of wet or dry seasons, and of course more in cultivation, as well as more liable to crop failures, than lighter soils. During the dry season the adobe soil, unless it has been very deeply and thoroughly tilled, becomes conspicuous by the wide and deep gaping cracks which traverse it in all directions, sometimes to a depth of several feet, precisely as in the "hog-wallow prairies" of the Southwestern States. Of course the effect of rains is here also similar in causing a bulging up of the masses between the cracks when the material which has fallen into the latter expands forcibly on wetting. Hence the "hog-wallow" surface is as familiar in California as in Texas; and the fact that a traveler outside of the Sierras in the dry season is rarely out of sight of some such land is eloquent as to the wide prevalence of the "adobe." On the steep hillsides of the Coast Range the sun-cracks aid in giving foothold to stock; and during the rainy season the water running into them to the bed-rock causes numberless land-slides, such as gave rise to the memorable case of Hyde *vs.* Morgan. As it is well ascertained that at a former geological period the entire interior valley, as well as the bay of San Francisco, was fresh-water lake basins, the bulk of the adobe soil would seem to repre-

sent ancient lake, or rather, perhaps, swamp deposits, which are therefore found in corresponding positions in most of the connecting valleys. On the bay we find usually only a narrow strip of sandy soil running along the beach; inland of this a level belt of black adobe (or at times salt marsh), from which there is a gradual ascent toward the foot of the Coast Range, the soil becoming lighter colored and mingled with bowlders and rock fragments. The nature of the materials, as well as the form of portions of this slope, characterizes them almost inevitably as the result of glacial action.

The peninsula on which San Francisco is situated is overrun with the dune sand drifted from the ocean beach for a distance of several miles south from the Golden Gate, so that the fixing of the sand and its conversion into soil is one of the chief problems of the gardens and parks of that city. The city of Oakland, also, is situated on a somewhat sandy, but nevertheless quite productive, soil; and land of a similar character, but stronger by admixture of the adobe, yet easily tilled, forms the soil of the fertile valleys in the plain lying between the eastern shore of the bay and the coast range, which are largely devoted to market-gardens and fruit-culture, and, farther from the cities, to that of barley. The comparative difficulty and more or less of uncertainty attendant upon the cultivation of the adobe soils, unless very thoroughly tilled, has caused a preference to be very commonly given to the lighter soils found nearer to the streams, which are formed of a mixture of the adobe with the river sediment, or, nearest the water-courses, of that sediment alone. It is suggestive of the character of the majority of California streams that the word "bottom," used east of the mountains to designate the well-defined flood-plain, is scarcely heard in the State, the more indefinite and general term "valley" being in general use. The obvious reason is that there is in most cases no very definite terrace, but a rather gradual slope from the bank to the bordering hills. The Sacramento and San Joaquin have not, as a rule, raised their immediate banks perceptibly above the rest of the flood-plain, because the sediment they carry is not such as will subside at the slightest diminution of velocity, but is apt to be carried some distance inland. At the points of its upper course the San Joaquin, and in the lower portions both it and the Sacramento, subdivide into numerous sloughs traversing wide belts of more or less marshy flats, subject to overflow, and covered with a rank growth of "tule." This name applies, strictly speaking, to the round rush (*Scirpus Lacustris*), which occupies predominantly the tide-water marshes, here as well as on the Gulf of Mexico. The farther from salt water, however, the more it is intermingled with (or locally almost replaced by) other aquatic grasses, sedges, and cat-tail flag (*Typha*), affording, together with the young "tule," excellent pasture nearly throughout the the year. Here, as elsewhere in such districts, the cattle soon acquire the art of keeping themselves from getting bogged, by maintaining a sort of paddling motion when on peaty ground, while draught-horses require to be provided with broad "tule-shoes." These tule lands, embracing a large number of rich and partly reclaimed islands, such as Union, Brannan, Sherman, and others, forming part of the counties of of Sacramento, San Joaquin, and Solano, continue with varying width along the east shores of Suisun and San Pablo Bays, and up the tributary valleys of Napa, Sonoma, and Petaluma, nearly to the limit of tide-water. It is noteworthy that, as regards salubrity, the tules, at least so far as they are within reach of brakish tide-water, are less liable to malarious fevers than the upper portions of the great valleys.

The soil of the tule lands is of two principal kinds: sediment land,

found chiefly along the Sacramento and other streams, carrying much "slum" from the hydraulic mines; and peaty land, more prevalent along the San Joaquin and its branches. The latter kind consists almost entirely of tule roots, in various stages of freshness and decay, to a depth of from two to twenty and more feet; in the latter case we have the "float land," which rests on the water-table and rises and falls more or less with it. Like the "Prairie Tremblante," near New Orleans, it often trembles under the tread of a man, but will nevertheless sustain herds of cattle without the least danger, its bulges forming places of refuge for them in time of high water. An excellent fuel has been made by pulping this mass and forming it into bricks like true peat. The tule lands were long thought to be worthless except for pasture purposes; but it has now come to be well understood that they are in large part of extraordinary fertility, and, if protected from overflow by levees, are almost sure to yield abundant crops every year, even in seasons when those of the uplands fail for want of moisture. In their reclamation the construction of levees is of course the first thing needful. The sediment land can then be taken into cultivation at once by the use of large sod-plows, resembling the prairie plows of the Western States. It is usual to burn off the rushes and native grasses previous to plowing, especially in the peaty lands where the plow would otherwise find no soil. But here the fire penetrates several feet down, either to the underlying soil or to moisture, leaving behind a layer of ashes so light that the plow is useless. At the proper season grain is then sown upon the ashes, and either brushed in or trodden in by sheep, and extraordinary grain crops are thus produced during the first years, the duration of fertility depending, of course, upon the soil underlying after the ashes have been exhausted. The tule lands bordering upon Tulare Lake are of a different character from those of the lower rivers. The soil is heavy, consisting of fine sediments mixed with gray clay and shell *débris*, contains a large supply of plant food, and with proper cultivation will doubtless prove as highly productive as are the soils of the Great Tulare Plains themselves.

The soils of the Mojave Desert seem on the whole to be rather light, whitish silts, of whose possible productiveness little can as yet be said, except that without irrigation culture is hopeless. In striking contrast with these close soils of the San Joaquin Valley are those which prevail south of the Sierras, San Fernando, and San Gabriel, in the Los Angeles Plain and its tributary valleys, the home of the orange, lemon, and olive in their perfection. The fine rolling uplands ("mesas") of that region are generally covered with a brownish, gravelly loam, from 8 to 20 feet in thickness, which, with tillage, assumes the most perfect tilth with ease. It is a generous, "strong" soil, varying locally so as to adapt itself to every variety of crop, yet readily identifiable by its general character from Los Angeles to San Diego. In most respects it may be considered a variety of the red soils of the Sierra slope already described, like which it appears to be pre-eminently adapted to fruit culture.

The soils of the plain to seaward of Los Angeles, and of the coast plains south of Santa Barbara generally, so far as not modified by the sediments of the streams, seem to be uniformly characterized by a very large amount of glistening mica scales, distributed in a rather sandy, dark-colored mass, destitute of coarse materials. They are easily cultivated and highly productive when irrigated, although not unfrequently afflicted with a certain taint of "alkali." This, however, when not too strong or salt, is here readily neutralized by the use of gypsum.

"Alkali" soil is the name used in California to designate any soil containing such unusual quantities of soluble salts as to allow them to

become visible on the surface during the dry season, as a white crust or efflorescence. They are of course found chiefly in low, level regions, such as the Great Valley, and the plains to seaward of the Coast Range; sometimes in continuous tracts of many thousands of acres, sometimes in spots so interspersed with non-alkaline land as to render it impossible to till one kind without the other. The nature and amount of salts in these soils is of course very variable. Near the coast the "alkali" is often little more than common salt, and can be relieved only by drainage or appropriate culture. At times we find chiefly magnesian salts, when liming will relieve the trouble. But in the Great Valley the name "alkali" is in most cases justified by the nature of the salt, which almost always contains more or less carbonate of soda, and sometimes potassa. The presence of these substances, even to the extent of a fourth of one per cent., while it may do but little harm during the wet season, results in their accumulation at the surface whenever the rains cease, and the corrosion of the root-crown, stunting, and final death of the plants. But when stronger, as is too often the case, the seed is killed during germination. Moreover, land so afflicted cannot be brought to good tilth by even the most thorough tillage. Fortunately, a very effectual and cheap neutralizer of this, the *true* "alkali," is available in the form of gypsum, which transforms the caustic carbonates into innocent sulphates. Wherever the amount of alkali present is not excessive, the use of gypsum relieves all difficulties arising from the presence of the former. Moreover, analysis shows that in many cases large amounts of important mineral plant-food, such as potash, phosphates, and nitrates, accompany the injurious substances; so that when the latter are neutralized, the previously useless soil may be expected to possess extraordinary and lasting fertility. Abundant deposits of gypsum have been shown to exist in many portions of the State since attention has been directed to its importance in this connection.

On the eastern affluents of the Sacramento River, the American, Bear, Yuba, Feather, and other streams heading in the region where hydraulic mining is practiced, a new kind of soil is now being formed out of the materials carried down from the gold-bearing gravels. The enormous masses of detritus washed into the streams, filling their upper valleys to the height of 60 feet and more with bowlders and gravel, while a muddy flood of the finer materials overruns the valley lands in their lower course, have given rise to a great deal of complaint on the part of farmers; and the "mining *débris* question" has been the subject of numerous lawsuits, and of much angry debate in the legislative halls. In some cases the lands so overrun are definitively ruined; in others the new soil formed is of fair quality in itself, but as yet unthrifty; in many, the best quality of black adobe is covered many feet deep with an unproductive "slum." By the same agency, the beds of the Sacramento and its tributaries have become filled to such an extent as to greatly obstruct navigation and to cause much more frequent overflows, whose deposit, however, appears to improve, in general, the heavy lands of the plain, as well as the tules. It is difficult to foresee a solution of this question that would be satisfactory to all parties concerned; the more as the navigation of the bay itself is beginning to suffer from the accumulation of deposit, the reddish sediment-bearing waters of the Sacramento being always distinguishable in front of the city from the blue water brought in by the tides.

NATURAL PASTURES.

The most obvious agricultural consequence of the climatic features previously outlined is that meadows and permanent grass pastures, and

even clover, are practically eliminated from the agricultural system of the State. They are possible only where artificial or natural irrigation supplies moisture throughout the season; and lands possessing this advantage are, thus far, as a rule, too valuable to be devoted to grass crops or pasturage. This sounds paradoxical in view of the fact that California is noted as a stock-raising country, and that her mountain-sides and valleys may be seen dotted with herds and flocks throughout the season. The newcomer instinctively pities the poor beasts who seem to be turned out on these brown slopes to starve from June to December. And yet when he examines them more closely he finds to his surprise that they are sleek and fat, and are contentedly occupied in picking up from the parched and fissured soil something that satisfies hunger; varying their diet occasionally by browsing on the foliage of shrubs and the lower branches of trees. Several circumstances contribute toward rendering these "dry pastures" available. First, and perhaps chief among them, is the rapid transition from the growing season to the dry in May and June; whereby the grass and other eatable herbage is cured into hay *in situ*, instead of withering slowly and losing its nutriment by withdrawal into the roots, or washing into the soil by rains. Hence the occurrence of any heavy rain subsequent to the setting-in of the dry season is regarded as a calamity by stock-men; for it leaches the dry pasturage of its nourishment, renders it unpalatable to stock, and sometimes causes it to become moldy in part. From the same cause, the real lean and hungry season for stock is from the time when the rains have begun (October or November) to that when the new grass becomes strong enough to afford adequate pasture. The latter epoch, so anxiously looked for, varies greatly from year to year. A universal welcome greets the first rain (usually about the middle or end of October), washing the dust of months from the evergreen oaks and laurels, and allaying that of the roads, which has long shrouded every team in an earthy cloud. But it will not please the farmer if it exceeds the moderate amount needed to wash the face of nature, or possibly to enable him to start his plow; for if it should be sufficient to start "the grass" into rapid growth at that early period, the chances are that no more may fall until Christmas, or even later, and that instead a succession of dry northers may sear the tender blades, or even dry up their roots. When the rains set in later, in November, they are more likely to continue at short intervals; and then the grass will be in good condition for stock by Christmas. But at times (as in 1878–'79) they may be delayed until near Christmas; or having commenced early, they may be interrupted by a dry season (as in 1876–'77), when the grass may not be available until February, and stock, as well as meat-eaters, will have a hard time indeed. During the growing season numerous native and introduced grasses contribute to pasturage. On roadsides and in waste grounds one of the commonest and earliest is the wild barley (*Hordeum jubatum*), commonly called by an unfortunate misnomer "Foxtail Grass", which is relished by cattle in its early stages, but later becomes not only useless but a serious nuisance, in consequence of the tendency of its barbed and pointed spikelets to adhere to any moderately rough object, and, if penetrable, to penetrate it by a crawling process, which in the case of clothes soon brings it into unpleasant contact with the skin of the wearer; while as a component of hay, or in dry pastures, it is really dangerous. Among the best ingredients of the spring pastures are six or seven species of native clovers, mostly annuals, and perishing at the setting-in of the dry season.

Apart from sun-cured herbage, properly so called, an important in-

gredient of the "dry pastures" is the dry pods of the "bur clover" (*Medicago denticulata*). This hardy plant flourishes under difficulties that would discourage most other forage plants from even attempting to make a living. When in its season it disputes even the hardest trodden paths, roadsides, and pastures with such hardy weeds as the bird grass (*Polygonum aviculare*) and the yellow centaury (*Centaurea solstitialis*, *Tocalote* of the Mexicans). It lies close to the ground, with small leaves and flowers; but in time becomes noticeable from being crowded with its prickly pods, spirally rolled into pellets, whose hooked bristles cling tenaciously to the wool of sheep and impart to it the commercially unprofitable epithet of "burry." But however objectionable from the wool-grower's point of view, these burs are among the most substantial ingredients of the "dry pastures," and are eagerly picked up by all animals, from the hog to the horse. This bur-clover is among the many plants of European derivation which have become so naturalized over the largest part of the State that few think of them otherwise than as native weeds. The Argonauts of 1849 already found the hills waving with the wild oat (*Avena fatua*) yielding a wild hay which at that time was sold at fabulous prices, and even now continues to be held in high esteem. Two species of crane's-bill (*Erodium cicutarium* and *moschatum*) are even more common here than in Southern Europe, and the first-named is esteemed as one of the most important natural pasture plants, being about the only green thing available to stock throughout the dry season, and eagerly cropped by them at all times. Its Spanish name of Alfilerilla (signifying a pin, and now frequently translated into "pin-weed") shows that it is an old citizen, even if possibly a naturalized one.

WEEDS.

To that process of naturalization of Old-World plants familiar to mankind, the California climate seems to be peculiarly adapted; for the commonest and most troublesome weeds of fields and roadsides are originally at home on the Mediterranean and Black Sea shores, and not usually found growing wild elsewhere. Thus the colza or rape-seed, under the common names of white mustard and wild turnip, everywhere takes possession of fields and waste places. The same is true, to a less extent, of one or two species of mustard proper (*Sinapis nigra* and *adpressa?*) and of the hedge-mustard (*Erysimum officinale*). Even the garden radish (*Raphanus sativus*) has escaped from cultivation to become a troublesome weed, often forming large patches, of a delicate rose-tint, in a landscape otherwise yellow with mustard and native poppies (*Eschscholtzia*). The larger mustard, often growing so high as to hide from view a man on horseback, is a formidable weed in portions of the San Joaquin and Sacramento Valleys, covering whole sections of land as a thicket, through which man or beast penetrates with difficulty. While the plants above mentioned embrace those immigrants whose coming and displacement of the native vegetation has exerted an important influence upon the face of the landscape and the operations of agriculture, there are numerous other weeds which, locally, give considerable trouble to the husbandman and gardener. The pimpernel (*Anagallis arvensis*), the spurrey (*Spergula arvensis*), several Old-World chickweeds, the omnipresent dog-fennel, hog-weed, or wild chamomile (*Anthemis Cotula*), and among the grasses the soft chess or brome grass (*Bromus mollis*, not unfrequently miscalled "buffalo grass"), the annual spear grass (*Poa annua*), the darnel (*Lolium temulentum*), a numerous contingent of the Goose-foot family (*Chenopodium album*, *Bonus Henricus*, *anthelminthicum*, several

Amaranths (*A. retroflexus*, *spinosus*, and others), the two cockle-burs (*Xanthium spinosum* and *strumarium*), and other homely weeds, both of Europe and the Atlantic States, greet the immigrant with their familiar, if not altogether welcome, faces. The number of these is continually increasing, some being as yet confined to a few localities, as, *e. g.*, the mouse-tail (*Myosurus*) to the peninsula north of the Golden Gate; the Canada thistle to the neighborhood of Chico; while the common purslane (*Portulaca oleracea*) appears dotted, here and there, all over the State. The advent of some of these is still historically traceable to the importation of some particular lot of seed, or to the unpacking of a box or crate of goods packed in straw; and in view of the direct communication of California by sea with all parts of the world, there is, of course, no limit to the possibilities of the importation of both foreign weeds and insects, save such as is imposed by climate. The latter, however, is so peculiarly cosmopolitan and tolerant, permitting both the currant and the orange to flourish in the same orchard, that we may fairly expect the weeds and insect pests of India and Siberia to unite in worrying the Californian farmer hereafter, unless some preventive measures are taken. Even now, the weed question has assumed exceptional importance in the agricultural practice of California, in interfering with the otherwise so desirable practice of dry sowing in summer-fallowed ground; and it is notable that, among the weeds so interfering, there is scarcely one of material importance that is a native. The legislative action so far taken refers only to the Canada and Scotch thistles; and, curiously enough, the law misses its mark so far as the latter is concerned, the plant intended to be reached by it being in reality not the true Scotch thistle (*Onopordon*), but the milk thistle (*Silybum*). Among the many resinous, clammy plants popularly designated as "Tar-weed," formidable from their effects on the pants or skirts that brush by them, there are several native composites, and (on the Sierra slope) one of the Mimosa family, but none is more troublesome than the imported Madia (*M. Sativa*), which is everywhere found in fields and waste grounds, though nowhere, so far as I know, in cultivation for its oily seeds.

FORAGE CROPS.

As already stated, the rainless summers in the part of California under consideration exclude from its agricultural system, at least on unirrigated land, both permanent meadows and clover. The search for forage plants suitable for such climatic conditions was early begun and is far from being as yet concluded. The most obvious expedient, adopted at the outset and still supplying the bulk of dry forage, is the cutting of the ordinary cereal crops for hay before the grain ripens. "Wheat hay" and "barley hay," which with oats similarly cured constitute the main mass of the hay crop, are among the Californian oddities that first strike the agricultural immigrant. Most of the late-sown grain, as well as so much of the early sown as from any cause does not promise a good grain crop, and the "volunteer crop" that commonly springs up from the seed shed in harvesting the previous season's grain on land left untilled, is devoted to this purpose, for which it generally becomes fit some time in May, according to location. Oddly enough, embarrassment not uncommonly arises on fresh and strong land from the fact that the straw is so strong and tall as to render it unsuitable for curing into hay. A great deal, also, is cut at too late a period, when the grain is almost full grown—it being well known that it is then that

the greatest total weight is harvested; the quality, however, is in that case of course injured.

During hay-making time (end of April to that of May) the weather is usually so dry that there is little difficulty about curing. There are no sudden thunder-storms to call for a hasty garnering of the hay. Sometimes, indeed, a late shower will give a superficial wetting to the shocks, necessitating their being scattered for drying; but with ordinary care in this respect there is rarely any excuse for damaged or musty hay. So little danger is there that injury from rains will occur after May, that the shocks are often left exposed for many weeks to the bleaching action of dew and sunshine. The regular practice, however, is to gather them into large rectangular ricks, built without much reference to protection from rain, but mainly with regard to the convenience for pressing into bales. This is mostly done by contract with gangs or "pressers," usually consisting of four men with a wagon and press, who perambulate the country from June to October. These men generally take up their lodgings under a hut of bales, which is all the protection needed at that season; and do their own cooking at some point outside of the ring of plowed ground with which, as a safeguard against fire, the ricks are circumscribed. Such hay-baling campaigns are sometimes chosen by persons needing a change from sedentary life as an opportunity for recruiting their health without expense, if not with much pecuniary advantage.

Even in this country, but little hay is handled in California without baling; and thus "bale-rope," from cut bales, is the universally recognized material for "tying up things," from a bundle to a broken wagon. Of late years soft iron wire has, to a considerable extent, come into use for baling hay; so that to stumble over a bundle of discarded "bale-wires" in the back yard is not at all out of the ordinary range of events.

Alfalfa.—Undoubtedly the most valuable result of the search after forage crops adapted to the California climate is the introduction of the culture of alfalfa; this being the name universally applied to the variety of Lucerne that was introduced into California from Chili early in her history, differing from the European plant merely in that it has a tendency to taller growth and deeper roots. The latter habit, doubtless acquired in the dry climate of Chili, is of course especially valuable in California, as it enables the plant to withstand a drought so protracted as to kill out even more resistant plants than red clover; as a substitute for the latter, it is difficult to overestimate the importance of alfalfa to California agriculture; which will be more and more recognized as a regular system of rotation becomes a part of the general practice. At first alfalfa was used almost exclusively for pasture and green-soiling purposes; but during the last three or four years alfalfa hay has become a regular article in the general market, occasional objections to its use being the result of want of practice in curing. On the irrigated lands of Kern, Fresno, and Tulare Counties, three and even four cuts of forage, aggregating to something like twelve to fourteen tons of hay per acre, have frequently been made. As the most available green forage during summer, alfalfa has become an invaluable adjunct to all dairy and stock farming, wherever the soil can, during the dry season, supply any moisture within two or three feet of the surface.

Grasses.—Of the ordinary pasture and meadow grasses of Europe and the East, but a few have to any extent gone into cultivation. One of the most unsuited to the climate, viz., Kentucky blue grass, is carefully nurtured by daily sprinklings as the chief ingredient of lawns, for which the Eastern immigrant generally maintains a preference, often satisfied

at an inordinate cost of money and labor, and sometimes of health. As water for household purposes is almost universally kept under pressure from elevated tanks or water-works, the hose and lawn sprinkler are probably in more general use here than in any other country; and innumerable attacks of rheumatism and malarious fever are traceable to their intemperate use, even to the injury of the coveted grass itself. But few attempts have as yet been made to find an acceptable substitute for the costly blue-grass lawn. Among those which promise best are the Italian rye grass, which remains green all summer without irrigation in the bay climate; and, with proper treatment, doubtless the Bermuda grass could also be used. In either case, fully six out of seven weekly sprinklings might be dispensed with. This rye grass (*Lolium Italicum, multiflorum*) has in some districts become so naturalized as to be cut for "volunteer hay," while at other points it is regularly cultivated with irrigation, if needed. In the tule lands and other naturally or artificially irrigated regions, the soft meadow grass (*Holcus lanatus*), under the singularly inappropriate name of "mezquite," as well as the orchard grass (*Dactylis glomerata*) have come into use for pasture as well as hay; but the latter is not found in market. So of the millets (*Panicum Italicum, Germanicum*), which are locally in use. Of late various species and varieties of sorghum are coming into favor; among these especially the Dhoura, or Egyptian corn, and the pearl millet (*Pennicillara spicata*). Other forage plants are under trial in various portions of the state; but thus far none can compare in importance with the cereal grasses and alfalfa. It is probable that hereafter some of the native grasses and clovers, now considered as weeds only, will be found profitable for culture.

STOCK-BREEDING AND DAIRYING.

Prior to the American occupation, the breeding of sheep, horses, and, to a less extent, of neat cattle, roaming in flocks over the extensive ranches, was the chief occupation of the inhabitants; and to a great extent the remnant of the original Spanish-Mexican population still clings to the old pursuit, which affords an easy livelihood, and permits of indulgence in that *dolce far niente* which seems to be impossible to the "Americanos," however varied may be the nationalities that compose the population of the United States. It thus happens that even where the "ranch" and stock are owned by Americans, the herders are to a great extent still the native "vaqueros," who, mounted on their hardy mustangs, and with the old-time lasso (more properly "lazo"), coiled around the horn of their high Mexican saddles, and rarely more than a rope to guide their steed, may be seen careering around the steep hillsides with a disregard of all the ordinary precautions against the breaking of necks that is quite straining to the nerves of novice lookers-on. As a matter of fact, accidents very rarely happen to these wild riders; and their efficiency in keeping in bounds and "corralling" the cattle intrusted to their care, on the most rugged ground, is remarkable. It is but fair to say, however, that their practice has been quite successfully imitated by other nationalities, and that many a swarthy herdsman nowadays responds more promptly to the Saxon or Norse salutation than to that of the Mexican-Spanish dialect.

The purely pastoral method of stock-raising is, of course, gradually receding before the advance of agriculture proper to the more thinly settled regions; maintaining itself, however, in some of the large ranches owned by parties declining to sell to small farmers. The obvious disadvantage of being entirely at the mercy of the seasons, thus sometimes

losing in a single dry year all the increase of a previous succession of favorable ones, has gone far toward the introduction of a safer system, in which the hardy and nutritious alfalfa serves to carry reduced numbers of stock of correspondingly higher quality safely through the dry months. In few States, probably, is the value of improved breeds more highly appreciated than in California; and nowhere, probably, can the best strains of the more important breeds be seen in greater perfection. The one domestic animal of common note, not as well represented in California as elsewhere, is the hog; the obvious cause of the comparative neglect being the absence of a sufficiently long and regular period of freezing weather, whereby the safe packing and curing of pork, hams, &c., is rendered too precarious. While, therefore, fresh pork of excellent quality is commonly found in the markets, the supplies of bacon, ham, and lard are, as a rule, furnished by the Western States, and partly by Oregon. Foremost in numbers among the rest is undoubtedly the *sheep*, in its double capacity of wool-bearer and producer of some of the best mutton in the world; a combination which has doubtless contributed much to the preference given it on the part of the somewhat inert native population. Easily satisfied with scanty pasturage, and in the southern part of the State scarcely needing shelter, the sheep is the very animal for the swarthy inhabitant of the adobe house, who loves to take his ease lounging on the airy veranda, asking of fate no luxury beyond a due allowance of cigaritos, and not at all envious of the greater comforts and riches of his unquiet, hard-working, and ever-scheming Saxon neighbor.

The common sheep of the country, while far from being a high-bred animal, is yet superior in many points to the stock commonly found in other countries, and its adaptation to the climate has rendered it profitable in cases where improved stock failed to pay. The Spanish Merino, whose blood doubtless runs in the veins of the native stock, seems to be best adapted to its improvement, and the best of this breed has been imported into the State. The wool-clip is among the most important products of South California; but it would seem that the attainment of the highest quality requires some change from the natural conditions of pasturage, which present too great a contrast between the wet and dry seasons to insure perfect uniformity of the fiber. This, however, can undoubtedly be accomplished by the introduction of the proper forage plants. In dry seasons, such as that or 1876–'77, the mortality among the larger flocks has sometimes amounted almost to annihilation. The sheep-owners of the plains, in order to save something, have driven their flocks to the foot-hills and valleys of the high sierras, leaving their route marked with the festering carcasses of the weaker animals, and sweeping every green thing before them, to the dismay of the dwellers in the invaded regions, who were thus sometimes themselves reduced to extremities. In ordinary seasons, this migration has its regular methods and routes, the herds ascending the mountains in the wake of the summer's drought, and returning to the foot-hills or plains to winter.

Of other fleece-bearing animals the Angora or Shawl goat has attracted considerable attention, and seems to succeed well; but the industry has not as yet assumed large proportions, chiefly, it seems, on account of the want of a regular market sustained by competition among the purchasers.

Of horses.—The Mexican mustang, a rather undersized yet hardy and serviceable, but proverbially tricky, race, descended from the Spanish breed, and therefore far from being inferior blood, still forms the greater portion of the horses in common use in California. The larger American horse brought from the Eastern States, although preferred for heavy

work, is not so well adapted to the mountains and requires higher feeding. The two varieties are of course rapidly mixing, and better blood than that of many California studs it would be hard to find anywhere. Fast horses and fast men have here, perhaps, more than elsewhere been the bane of the agricultural fairs, whose real and important objects have, until lately, been most frequently swallowed up in that of an opportunity for betting and horse-racing, to the disgust of the agriculturists. The introduction of the more useful breeds has not, however, been neglected, as is evidenced by the fine Norman and Percheron dray-horses seen on the streets of San Francisco. A tolerable riding-horse can probably be bought for less money in California than anywhere else in the United States, the mustangs (which are generally of light build) being bred in large herds on pastures, with little care and therefore little expense. But when the excursionist pays twenty or thirty dollars for his steed he must not expect to find it trained to gentleness and affection, for the "breaking-in" process which these animals undergo on the ranches has but few of the features that Mr. Rarey would recommend. The unwary horseman will pay for his experience by many an unexpected nip or kick, or by being left on foot at inconvenient distances from his destination, in consequence of a dexterous slip of the rein from his arm, a sudden rush under a tree with low branches, or a "bucking" process of exceptional suddenness and violence. The mustang will, ordinarily, abandon these practices in proportion as it feels that the rider is "up to" its tricks; but the latter should never be found altogether off his guard against them, as he might safely do with a well-educated horse.

The *neat cattle* of California, previous to the American occupation, were chiefly of a type whose ancestry may still be seen on the pastures of Andalusia—a middle-sized race, lightly built, bearing medium, long, but aggressively-pointed horns, which, combined with an irritable temperament and a fair capacity for speed, render the proximity of a herd of these cattle not altogether pleasant to the novice. Like its cousin, the Texas Long-horn, now familiar to the West, it is a hardy, prolific race, yielding a fair quality of beef, and a thick and tough hide, well adapted either to the production of sole leather or to that of the strong rawhide thongs, which serve the Mexicans in place of rope, twine, nails, and other domestic appliances deemed indispensable by more pampered nations. As milkers, however, its cows are a failure; nor are its oxen remarkable for either docility or disposition to engage in agricultural pursuits, being the natural result of a nomadic life on wild pastures, from which they were driven in and "corraled," for branding or slaughtering, only a few times in the course of the year. All this, of course, has materially changed since the advent of the American. The immigrants brought their cattle with them over the plains, and found no reason to exchange the progeny of these for the pugnacious natives. The latter have, therefore, greatly diminished in numbers, and are little seen in the more populous regions, retiring before the advance of culture like their original masters. The gentler race that accompanied the Americans across the Rocky Mountains now dots the plains and foot-hills of the Great Valley of California; and since their weaker brethren mostly perished on that trying and weary voyage, a process of selection has taken place, as a result of which the worst breeds of "scrubs" are rarely seen in the State. Moreover, the tendency to improvement that is so apparent in the use of perfected appliances of every kind has manifested itself at least equally in the importation of the best breeds of neat cattle, among which the Short-horn, Jersey, Alderney, and Ayrshire, and

to some extent the Devon, have found especial acceptance, and are represented by some of their best strains. Much discussion prevails as yet in regard to the relative merits of the various breeds under the peculiar climatic conditions of California; but already they are beginning to become localized in accordance with their several adaptations to local climates, which can be found to suit all; and perhaps in time the tawny race of the Swiss Alps will find a congenial range on the Sierra Nevada.

The production of beef is as yet limited by the requirements of home consumption; but the dairy interest is rapidly assuming a wider range, and with an increasing knowledge of the modifications of the processes demanded by climatic conditions, the quality of dairy products is improving so much that as a market for all but the choicest kinds, California will soon be closed to the Eastern producer, and will, perhaps, compete with him in foreign markets. The average quality of the milk supplied to San Francisco and Oakland, from the numerous "dairy ranches" on the coast and bay and in the Coast Range, is greatly superior to that generally found in Eastern cities; one obvious reason being that in the absence of distilleries there is no opportunity or temptation to feed the cows on unhealthy offal; nor do the sleek and healthy cows that range the breezy hills of the coast ever need to be propped or slung up in order to enable them to stand the milking process. It is believed that an undue increase of bulk from a too free use of the pump is all that the milk consumers of these cities ever have to complain of.

Butter is now very generally of fair quality, some brands being quite up to the "gilt-edge" standard. It is usually sold in rolls supposed to weigh two pounds, but in reality always several ounces below that weight—a circumstance so well understood, however, that the practice hardly amounts to deception. The price per roll rarely falls below 50 cents to the consumer, and ranges more generally from 60 cents to $1.10 about Christmas time, when even that which has been packed in casks with salt during the spring and summer brings 70 cents.

The intimate connection (to the housekeeper at least) of butter with *eggs* suggests a few words on that subject in this place. The demand for eggs is unusually large in California cities, in consequence of the commonly prevailing practice of not only single men and women, but also small families in moderate circumstances, living in lodgings, and taking an easily made breakfast of eggs, bread, and coffee, thereafter going to the restaurant for dinner, and thus avoiding the pains and pleasures of housekeeping. Whatever may be said of the desirability of this practice in a social point of view, it manifests its effects in the price of eggs, which rarely falls below 30 cents per dozen to the consumer, and is more frequently among the fifties and upward; even so, *fowls* cannot often be bought at less than 80 cents apiece, and $1 is a common price. Poultry-keeping is therefore a very remunerative pursuit when judiciously managed, since feed is as cheap as elsewhere; and it is one of the industries which have not, as yet, been overdone. There are no special difficulties to be overcome in poultry-raising in California; yet a great deal of money has been lost in attempts made by persons unfamiliar with its proper management. There is no lack of the improved breeds, but among them the Leghorns seem to enjoy the widest acceptance at this time.

Apiculture is common throughout the State, and nowhere is the product of the bee of finer flavor, or marketed in a more attractive form. The best of improved hives are in common use, and the market is always supplied with the frames filled with the delicate, almost white, comb. Of course the improved varieties of bees have been introduced, and in the

southern part of the State especially this industry is practiced on a scale not often to be met with elsewhere, as can readily be seen from the figures showing the export, amounting in 1878 to no less than three and a half millions of pounds. How kindly the honey-bee takes to even the desert region of that country is well illustrated in what has been supposed by many to be a "snake" story, but what is an unquestionable fact; namely, that some miners prospecting in Arizona struck a regular "fissure vein" of honey in a rocky ridge, where the bees had been making deposits for years, and, although the vein-contents were not what they had been searching for, they took to it kindly and worked it, extracting therefrom a fabulous amount of honey. Another adventurous colony took possession of the court-house cupola at San Bernardino, and had accumulated several hundred pounds of honey when discovered. The bee is very fond of the flower of the mountain sage (*Artemisia*), as well as of a number of other desert plants, and is thus afforded unlimited pasture through three-fourths of the year. It seems that certain kinds of flowers, not yet identified, impart to the honey a tendency to become turbid after straining, from the separation of minute white crystals, whose nature has not as yet been ascertained. Such honey, whose other qualities are generally of the highest, has been unjustly suspected of adulteration in Eastern and English markets. The prejudice arising from this merely conventional defect will soon be overcome, and South California will doubtless become one of, if not the largest, honey-producing country of the world.

Silk-culture is at present almost extinct in California in consequence of the reaction against the mania for this industry that began in the State some eighteen years ago and raged with unabated fury for several years, inflicting severe losses upon those who indulged in the popular delusion that the silkworm would thrive in the State without any special precautions in the way of shelter and such intelligent care as can be given only by those versed in its treatment. Some of the airy sheds that were supposed to be an adequate protection against the comparatively slight changes of temperature are still extant, as monuments of that flush period when mulberry trees were thought to be the only nursery stock worth having. It can hardly be doubted that the advantages offered by a climate in which the food of the worm is available during all but two or three months in the year, yet free from the excessive heat that elsewhere militates against the insect's well-being, will ultimately assert themselves in the resumption of silk-culture in a calmer mood. It has been very successfully ketp up, on a small scale, by Mr. Gustavus Neumann, of San Francisco, showing pretty conclusively that it is not the nature of the climate, but adverse commercial and industrial circumstances that at present keep the rise of silk-culture in check.

Alongside of the useful animals of California, some mention of the injurious ones should also be made. The grizzly bear and puma, or California lion, have ceased to possess more than an occasional local interest to farmers; but the sneaking coyote, freed from the competition of the stronger animals, finds the conditions of his existence rather improved than otherwise by the multiplication of flocks on the mountain sides, where the thick "chaparrel" affords him a refuge from which it is not easy to dislodge him. Both he and the wildcat still range in sight of "the city," and make their presence felt in occasional inroads upon valuable flocks. But the damage thus done is insignificant in comparison with the ravages of a much more peaceful animal, to which civilization has afforded additional safety and means of subsistence. This is the ground-squirrel (*Sciurus Fossor*), which the immigrant at first is inclined

to greet as an old acquaintance, it being very like the gray squirrel of the Western woods. It lives, however, exclusively in underground burrows, each occupied by from two to thirty individuals; and from this safe retreat it levies its assessments upon the grain-fields with all the certainty and pertinacity of the tax-gatherer, not unfrequently harvesting as its share over one-half of the growing crop, and pursuing the grain into the stacks and sacks, and even to the barn itself. Passing through the grain-fields after harvest, one may see the wary little animals scattering hastily to their holes by hundreds, like young spiders from a nest; then, turning on their heels in the burrow, they will sit erect at the entrance, uttering a peculiar whistle, the signal of danger to their neighbors. The pot-hunter, imagining that he has a fine chance, will find them drop into their holes at the very instant that he pulls the trigger; and should he succeed in putting a few shot through its tough hide, the chances are that the wounded animal will wriggle into its hole, out of reach, before the marksman has time to reach the spot. While not first-class eating, yet both their carcasses and skins find a ready sale; but even skilled hunters appear to make but little impression upon their numbers in favorable ground. Wheat poisoned with strychnine is the remedy that has been thus far most used for their destruction, but the want of coöperation by neighbors renders all efforts for their extermination futile, and other domestic animals, as well as the farmers' friends, the birds, too often fall sole victims to the poison. Legislative enactments also have failed to prove efficient in compelling united action. Of late the use of carbon bisulphide has been introduced with a fair degree of success; and whenever the home manufacture shall so reduce the price of this substance as to bring it within the farmers' reach, there may be reasonable hope that the "squirrel nuisance" will be abated.

Another animal equally destructive on a smaller scale is the gopher (*Thomomys Umbrinus*), an animal of the aspect of a small rat, with a short, stumpy tail. Its shallow, winding burrows are marked by small piles of earth-crumbs at their outlets, and by the unaccountable dying-out of trees, shrubbery, and flowers when at their best, the animal feeding on their roots unperceived. The gopher can do little damage where the ground is kept in perfect tilth, and leaves in disgust when it finds its burrows falling in behind it. But in plantations of young trees, in lawns, and the like, its ravages are most grievous, and difficult to check.

Of insects, the *Phylloxera*, and the "scale-bugs" attacking the pear and orange, are those most complained of. The Colorado potato-bug does not seem to have made its way across the mountains. The Rocky Mountain locust-grasshopper is reported to have made its appearance occasionally in the mountain counties; but it is possible that other species have been mistaken for it when, as sometimes happens, they have appeared in unusual numbers. This year an invasion by one of these (*Œdipoda Atrox*) is reported as doing serious damage in Sierra and Tulare Counties. The caterpillar, which occasionally appears in countless numbers, completely denuding the live-oaks, and is then scarcely seen for several years, seems to be gradually enlarging the scope of its appetite, and attacks the orchards. The cut-worm and codling-moth also are increasingly complained of; yet, on the whole, insect pests do not as yet excite much alarm in California, despite the fact that they are undeniably on the increase, both in numbers of the same species and in new ones being constantly introduced by sea and land.

CEREAL CROPS.

Of all the field crops grown in the State, wheat is the most important at this time. It was the first culture on a large scale introduced on the

subsidence of the gold fever, and the returns received proved to be so much greater and more certain than those from the placer mines that it extended rapidly, and has ever since remained the largest and most generally appreciated product of California agriculture. The amount produced in 1878, an average year, was 22,000,000 of centals, of which 8,069,825 were exported as grain, and about 500,000 barrels of flour. In the markets of the world the wheats of the Pacific coast are noted for their high quality—the plumpness and light color of the "berry," and the high percentage of first-class flour it furnishes in milling. At home the extraordinarily high product per acre of forty to sixty bushels, and even more, under very imperfect tillage, for a number of consecutive years, forms a strong incentive to this culture. Nor is the California wheat-grower obliged to be very careful in the choice of his seed. Probably every known variety of wheat has in the course of time been brought and tried here; but all, in a short time, seems to assume very nearly the same peculiar California type, upon which, in fact, it would seem hard to improve materially. It is almost ludicrous, at times, to compare the eastern seed with its California offspring, which has undergone the "swelling process" of one season's growth in her generous soil and climate. It is but fair to say that substantially the same peculiarities are observable in the wheats of Oregon, grown in the valley of the Willamette and on the plains of the Upper Columbia. Since the growing season in the greater part of California extends, with little interruption from cold, from the beginning of November to June, the distinction between winter and spring grain is also in a great measure lost. The farmer plows and sows as early as practicable, watching his chances between rains, in November and December if he can, in March if he must, or at any convenient time between; increasing the amount of seed sown per acre in proportion as there remains less time for the grain to tiller. Should the ears fail to fill, he can still make hay.

Much discussion has been had concerning the merits of early as compared with late sowing. The objections against the former practice are that copious early rains may start the growth too rapidly, the chances being that in that case but little more water will fall until Christmas. It is true that the weather-wise may sometimes gain materially by delay in sowing; but the general result of experience seems to be that it is better in the long run to take the risk of having to sow twice, rather than that of being kept from sowing at all, until too late, by persistent rains. It has therefore become a very common practice to "dry-sow" grain in summer-fallowed land in September and October. The seed lies quiescent in the parched and dusty ground until called forth by the rains, and in clean fields and ordinary seasons such grain generally yields the highest returns. The preparation of the ground for the crop on the large wheat farms is usually made by means of gang-plows with from two to six shares, drawn by from three to five horses or mules, three animals very commonly walking abreast. At the critical season it is not uncommon to see half a dozen such implements and teams at work in a single field, closely followed by a wagon carrying seed-grain and the centrifugal sower, which showers the grain upon the fresh-turned furrows, in strips thirty or more feet wide. Before the day ends the great (usually flexible) harrows have also performed their work, and 30 or 40 acres of what was a stubble field in the morning have been converted into a well-seeded grain field. Of late, appliances for seeding and covering have been attached to the gang-plows themselves, so that the whole task is performed in one operation—certainly the perfection of labor-saving machinery. Seed drills are as yet

in but limited use; although nowhere, probably, would drilling be more desirable, in order to admit of subsequent culture, for want of which crops often totally fail on the heavier soils. During the rainy season the covering is often done by rolling alone, and on harrowed ground the roller is frequently used later in the season, in order to compact the surface so as to mitigate the drying effects of "northers."

In the grain harvest (which begins in the second week of June) the "wholesale" mode of procedure is equally prevalent. The scythe is used only to cut the way, and that on small farms; then follows the reaper, hired if not owned by the farmer himself. But the binding and shocking process that is to succeed is far too slow for the large grain-grower, who has his hundreds, and sometimes thousands, of acres to reap within the short time allowed by the exceedingly rapid maturing, which threatens him with serious loss by shedding, the air being at that season very dry even at night. His implement is the giant header, pushed into the golden fields by from four to eight horses. Its vibrating cutters clip off the heads with only a few inches of straw attached, on a swath 16 and even 28 feet wide, while a revolving apron carries the laden ears to a wagon driven alongside, and having a curious, wide, slanting bed for their reception. Several of these wagons drive back and forth between the swaths and the steam thresher, where, within half an hour, the grain that was waving in the morning breeze may be sacked ready for shipment to Liverpool. Even this energetic mode of procedure, however, has appeared too slow to some of the progressive men in business, and we have seen a wondrous and fearful combination of header, thresher, and sacking-wagon moving in procession side by side through the doomed grain. If this stupendous combination and last refinement shall prove practically successful, we shall doubtless next see the flouring-mill itself form a part of this agricultural pageant. Where farming is not done on quite so energetic a plan, the reaped and bound grain being at that season perfectly safe from rain, is left either in shocks or stacks until the threshing party comes around, mostly with a portable engine often fed with straw alone, to drive the huge "separator," whose combined din and puffing will sometimes startle late sleepers, as it suddenly starts up in the morning from the most unexpected places. Two wagons usually aided by some "bucks" (a kind of sledge-rake, which also serves to remove the straw from the mouth of the thresher) feed the devouring monster. In an incredibly short time the shocks or stacks are cleared away and in their stead appear square piles of turgid grain-sacks and broad, low hillocks of straw. Both products often remain thus for six or eight weeks, the grain getting so thoroughly dry in the interval that there is frequently an overweight of five or more per cent. when, after its long passage in the damp sea air, the cargo reaches Liverpool. The moral question thus arising as to who is entitled to the benefit of this increase I will not pretend to determine; but the producers say that they rarely hear of any differences in their favor.

The manner of disposing of the straw is one of the weakest points of California agriculture. Near to cities or cheap transportation, much of it is baled like hay, and finds a ready market, but in remote districts it is got rid of by applying the torch; and these "straw fires" habitually redden the autumn skies as do the prairie fires in the western States, covering the whole country with a smoke haze, as a faint reminiscence of the Indian summer, which is not otherwise well-defined on the Pacific coast. This holocaust of valuable materials, which might be made the means of some slight return of plant-food to the soil, is a standing reproach to those who practice it; yet they have some excuse in the fact that the

peculiarities of the climate do not make it as easy to convert it into manure as is the case in countries having summer rains. For in winter the temperature is, after all, too low to favor rapid decay, while during the summer months, the intense drought soon puts an end to fermentation. It therefore takes two seasons to render the straw fit for plowing in; and in the mean time, as left by the thresher, it occupies considerable ground. As yet, the conviction that straw-burning is penny-wisdom and pound-foolishness has not gained sufficient foothold to induce the majority of wheat-growers to take the pains of putting the straw into stacks with concave tops, to collect and retain the water. But those who have done so report that the resulting improvement of the soil pays well for the trouble. The practice of burning will, of course, disappear so soon as the system of large-scale planting gives way, as it soon must, to that of mixed farming on a smaller scale.

Of the other cereals, *Barley* and *Oats*, are the only ones that can as yet lay claim to general importance; and the methods of culture are much the same. Like the wheats, so the barleys of California are of exceptionally fine quality, that of the "Chevalier" variety being so eagerly sought for by eastern brewers that but little of it finds its way into California-brewed beer. The common (six and four rowed) barleys are, however, themselves of such high quality that the absence of the highest grade grain is certainly not perceptible in the quality of the beers, into which, unlike most of its eastern brethren of Saint Louis and Chicago, nothing but barley and hops find their way. The various kinds of *Oats* are produced for home consumption only, the difficulty being very commônly that the straw becomes so strong as to interfere seriously with its use for forage. Rye is grown to some extent in the mountain counties, and yields a splendid grain, called for chiefly by the taste of the German population for rye bread. Some Polish wheat (*Triticum polonicom*) is grown under the name of "white rye." *Maize* is thus far grown, but to a small extent compared with wheat, barley, and oats; not, however, because of any difficulty in producing corn, which, both as to quality, size, and yield per acre, can compete with any in the Mississippi Valley. The large foreign element in the population limits the demand for corn-meal, and, as before remarked, on account of the mild winters, hog-raising on a large scale is not likely to become important in the State. A good deal, however, is planted for green-soiling purposes in connection with dairies. The planting is generally done very late in April, and in May after everything else has been attended to, since in the coast climate a crop of corn is often made without a drop of rain from the time of planting, when the season has been one of abundant moisture. Of late, several millets, and among them especially the *Dhoura* or Egyptian corn, are coming into favor. The Dhoura, though not as much relished by cattle as maize fodder, will admit of three cuttings each season, when irrigated, and the meal made from its grain is by many preferred to corn-meal, while as a chicken-feed it is, apparently, superior to anything else.

MISCELLANEOUS FIELD CROPS.

Of other field crops, the "*beans*" that formed the chief solace of the Argonauts of early days are still prominent, especially where the Mexican element is somewhat strong. To them "frijoles" are still the staff of life, supplemented by the "tamales," the native preparation of the "roasting-ears" of green corn.

The *Irish potatoes* grown in California are not, as a rule, of first qual-

ity, but incline to be watery. The tuber is largely imported from Utah under the name and style of "Salt Lake potatoes," albeit much that is sold under that brand is of California growth. The *sweet-potato* flourishes especially in the lighter soils of the coast south of San Francisco; its quality would not be likely to be criticised by any but those who have been accustomed to the product of the Gulf States or of the Antilles.

The big *pumpkins* of California have acquired a world-wide reputation not unlike that enjoyed by the sea serpent. The unprejudiced observer, however, readily appreciates the fact that when a well organized pumpkin has ten months' time to grow instead of three or four, it has every reason to give a corresponding account of its stewardship. But while a laudable ambition to excel may result in the production of three-hundred-pound pumpkins, it is but fair to say they are not the rule; being inconvenient to handle, and, like other organisms exceeding a certain age, inclined to be hard and tough. The same is true of mammoth beets (mangel-wurzel), carrots and turnips, which, when left out in the field during a mild winter, continue incontinently to grow and develop until the time comes to put in another crop. The dairy-men and stock-breeders raise these crops largely and are chiefly responsible for the production of the monsters.

The *sugar-beet* succeeds admirably in a large portion of the State, and in appropriate locations yields a juice of extraordinary richness; as much as 19 per cent. is clarified in some cases (but I can vouch for 15 only from personal experience), and a fair degree of purity. Several prosperous beet-sugar factories already exist, the failures reported having apparently been due to mismanagement. It is difficult to see why, with such material and the possibility of keeping up the supply for nine months by the planting of successive crops, this industry should not become one of the most important and lucrative in the State, and fully able to compete with any sugar-cane planting that may hereafter be introduced in the southern portion of the coast.

Hop growing is an important industry in the middle portion of the State, especially in the Sacramento Valley and in the Russian River region, north of San Francisco Bay. The product is of excellent quality, and is much sought after by Eastern brewers.

Of other crops of minor or only local importance may be mentioned the culture of *pea-nuts*, chiefly in the coast region south of San Francisco; of the chiccory root, in the neighborhood of Stockton, supplying a large amount of the parched and ground "old government Java coffee" sold by grocers. In the same neighborhood the culture of the "*Persian insect-powder plant*" *(Pyrethrum carneum)* is being successfully carried out, the product being in very general requisition on account of the prevailing abundance of fleas. This neighborhood supplies a quality of *mustard* that is somewhat overwhelming to the novice, and even for plasters should be diluted with flour. Were *rape-seed* oil in demand, the fact that the whole State is overrun with the plant that produces it, as a most troublesome weed, proves what could be done with it if fostered.

HORTICULTURAL PRODUCTS.

Nothing, probably, strikes the new-comer to California more forcibly, and nothing certainly more agreeably, than the advantages offered by a climate where plants can ordinarily be kept growing from ten to twelve months in the year, provided water is supplied. The immigrant desiring to make a home for himself is delighted to find that the rapid growth

of shrubbery and flowers—and among them many that he has so far seen only nurtured in greenhouses—will enable him to create around him in the course of three seasons, on a bare lot, a home atmosphere that elsewhere it would have required ten or more years to establish. The housewife, however industriously disposed, is not ill-pleased to find herself relieved from the annual pressure of the "preserving season" by the circumstance that fresh fruits are in the market at reasonable rates during all but a few weeks in the year; so that a few gallons of jellies is all that is really called for in the way of "putting up." It is not less pleasing to her, as well as to the rest of the family, that a good supply of fresh vegetables is at her command at all seasons, and that the Christmas dinner, if the turkey *does* cost 30 cents a pound, may be graced with crisp lettuce, radishes, and green peas just as readily as it may be celebrated by an open-air picnic on the green grass under blooming bushes of the scarlet gooseberry. Of course there are seasons of preference for each vegetable, but among the great variety naturally introduced by the various nationalities there are few that cannot be found in the San Francisco market at almost any time in the year—if not from local culture, then from some point between Los Angeles and the mouth of the Columbia. The truck-gardens are largely in the hands of the Italians and Portuguese, who have brought with them from their home habits of thrift; and their manure piles, windmills for irrigation, and laborious care of their unceasing round of crops on a small area, render their establishments easy of recognition. Their products are distributed partly by themselves, partly by the ubiquitous Chinese huckster, trotting with his two huge baskets under a weight that few Caucasians would carry for any length of time. Not a few Chinese also are engaged in the truck-farming business. The vegetables are in general of excellent quality, and it may be truly said that in no city in the United States is the general quality of fare so good, so well adapted to every variety of taste, and, last but not least, so cheap, as in the city of the Golden Gate; and nowhere is the decoration of even the humblest homes with flowers and shrubbery more universal and at the same time so generously aided by nature.

In no department of industry, probably, is the reputation of California better established than in regard to *fruit culture*. Its pears seem to have been the pioneers in gaining the award of special excellence; grapes and cherries have rapidly taken a place alongside, and, last, oranges and lemons have come to dispute the palm with Sicily and the Antilles. The most striking peculiarity of California fruit culture is its astonishing versatility, not to say cosmopolitanism; for the variety of fruits capable of successful culture within the limits under consideration in this article probably exceeds, even at this time, that found elsewhere in any country of similar extent, and is constantly on the increase by the introduction of new kinds from all quarters of the globe. Doubtless, in time, each district will settle down to the more or less exclusive production of certain kinds found to be most profitable under its particular circumstances, so far as the large-scale cultures are concerned; but whosoever raises fruit mainly for home consumption will hardly resist the temptation offered by the possibility of growing side by side the fruits of the tropics and those of the north temperate zone—the currant and the orange, the cherry and the fig, the strawberry and the pineapple, the banana and plantain, as well as the apple and the medlar. It would be supposed that the quality of these products must of necessity suffer grievously under the stress of their mutual concessions of habit; and this, of course, is true as regards the highest qualities of the ex-

tremes, under the judgment of the expert, but unperceived to a surprising degree by the taste of the public in the general market. The oranges grown in some of the sheltered valleys of the Coast Range, and on the red soils of the Foot Hills, as far north as Butte County, often successfully dispute the precedence of the product of Los Angeles and San Bernardino.

In view of the short time within which this industry has developed, and of the multitude of nationalities which have taken part therein, it is not surprising that many important questions relating to it should still remain unsettled, and that the best regular routine for the several districts, or even for general practice, should as yet not have been established. Too many different varieties, whose adaptation to the local and general climate is undetermined, fill the orchards, and give rise to immense quantities of unmarketable fruit, that ultimately fall to the share of cattle and hogs. The high price of labor and of transportation from remote districts condemns another large part to a similar fate, especially in favorable seasons, when the local market soon becomes glutted with fruit unable to bear shipment to the East. Curiously enough, even at such times, the prices of fruit to the consumer are generally higher than is the case at corresponding times in the Western States, showing irrefragably that the cost of production is higher, and consequently that only fruit of high quality can bear exportation. Inattention to this point has rendered unprofitable, or worse, many of the refrigerator-car shipments heretofore made, and the same want of proper care in assorting the various qualities is one of the chief causes of frequent business failures of those supplying the markets of San Francisco. This practice, however, is fast being improved upon, and the disposal of the surplus fruit by drying is beginning to relieve, to a very great extent, the glut that has often depressed prices below the paying point. The exportation of dried fruits of all kinds is doubtless destined to become one of the most important branches of agricultural industry in the State, both on account of quality and of the natural facilities for the drying process offered by the dry summer air. It is found to be absolutely necessary to exclude in the drying operations all access of insects, which otherwise lay their eggs on the fruit and spoil it within a year. This is now very generally and effectually accomplished by the use of the best drying apparatus, not uncommonly in co-operative factories erected by companies or granges. The quality of the prunes, plums, apricots, pears, &c., cured by some of these establishments is not behind the best of the kind imported from France and Italy, but as yet the neatness and convenience of the packages is not so generally what would be necessary to render them equally attractive to the purchaser.

While the orange, lemon, lime, and other sub-tropical fruits are more or less in cultivation up to the northern third of the State, they form the specialty of Los Angeles, San Bernardino, and adjoining counties, where also the pineapple, banana, guava, and other more strictly tropical fruits are mainly under trial. In a measure, what has been said above of the more northern fruits applies here also. While much fruit of the highest quality is produced, much also is still in the experimental stage, and some very poor lots are occasionally thrown upon the market. The subject has lately, however, been earnestly taken in hand by the young but proportionally energetic Horticultural Society of South California, in which a number of the most intelligent men have combined to determine in the shortest possible time, by systematic experiments, discussion, and scientific investigation, in connection with the agricultural department of the university, the practically important questions relating to this

culture. While the orange and lemon product is marketed without difficulty and at good prices, the millions of excellent limes borne by the hedges customary in the southern part of the State are still mostly allowed to decay where they fall. The manufacture of citric acid can hardly fail before long to put an end to this waste of precious material. The pomegranate, which is to some extent similarly used, generally finds a ready sale for its fruit. The olive, so generally found around the old missions as a relic of the past, has not so far found its place in general culture; and on the shelves of the grocers in the cities we still find the same mixtures of cotton-seed, peanut, and other oils, with a modicum of the genuine product of the olive, that form the standing complaint of salad-eaters throughout the United States. The subject of olive culture has of late attracted considerable attention, and small quantities of excellent oil have been made in various parts of the State, proving beyond cavil that its production can be made an important industry. The culture of the fig in California is coextensive with that of the vine, and both fresh and dried fruit of the highest quality is found in the market.

As to *nuts*, the European *walnut*, Italian *chestnut*, and *almond* are those whose culture on a large scale has been successfully carried out. The filbert may also be mentioned. Of these, the almond has been made the subject of the largest experiments, and, as might be expected, there have been numerous disappointments in consequence of the selection of unsuitable localities, subject to light frosts at the time of bloom. The best results have been obtained in situations moderately elevated above the valleys, "thermal belts," where the cold air cannot accumulate. The quality of the product leaves nothing to be desired, where proper care is had in selection of varieties.

The *Japanese persimmon* promises here, as in the Southern United States, to prove an important acquisition. The *jujube*, the *carob*, the *pistachio nut*, and many others are under trial.

Of small fruits, the *strawberry* is in the market during the twelve months of the year. *Raspberries* and *blackberries* are largely grown, both for market and canning. The *currant* is of especial excellence and size, and is extensively grown between the rows in orchards. *Gooseberries* have not been altogether successful in general culture.

A good deal has been said and written about *coffee* culture. It was currently reported that a kind of coffee grew wild in the foot-hills, and of course the real coffee must succeed. The "wild coffee," however, is simply the California buckthorn (*Frangula Californica*), and of course no more suitable for a beverage than turnip-seed. True, coffee trees are now growing at numerous points in the State, but it is not probable that the culture will prove a success outside of South California.

GRAPE CULTURE AND WINE-MAKING.

The grape-vine was among the culture plants introduced earliest by the Catholic missionaries. The similarity of the California climate to that of the vine-growing regions of the Mediterranean would naturally suggest the probable success of vine culture, corroborated by the fact that a native vine, albeit with a somewhat acid and unpalatable fruit, grows abundantly along the banks of all the larger streams. The grape variety introduced by the missionaries, and still universally known as the "Mission" grape, was probably the outcome of seed brought from Spain; it most resembles that of the vineyards which furnish the "Benicarlo" wine. It is a rather pale-blue, small, round berry, forming at times very large and somewhat straggling bunches. It is very sweet,

especially in South California, has very little acid, very little astringency, no definite flavor, and, on the whole, commends itself as a wine-grape only by the abundance of its juice and its great fruitfulness. The American immigrants found this vine growing neglected around the old missions, along with the olive, fig, and pomegranate. It soon attracted the attention of the European emigrants from wine-growing countries, was resuscitated and propagated, and still forms the bulk of the vineyards of California. We have good testimony to the effect that the wines made by the missionaries were of very indifferent quality, owing partly, of course, to the inferiority of the grape used, but chiefly to the primitive mode of manufacture; the entire caskage consisting of a few large, half-glazed earthenware jars (*tinajas*), from which the fermented wine was rarely racked off, being mostly consumed the same season. Still, the luscious grapes and refreshing wines of the missions are dwelt upon with all the delight that contrast can impart by travelers just from the fiery ordeal of the Arizona deserts or the thirsty plains of the Upper San Joaquin. The European wine-makers soon improved vastly upon the processes and product of the padres, but, in accordance with the fast ideas of the early times of California, they imprudently threw their immature product upon the general market, and thereby damaged the reputation of California wines to such a degree that it is only of late years that the prejudice thus created has been overcome, not only in consequence of better methods of treatment, and greater maturity of the wines when marketed, but also, and most essentially, by the introduction of the best grape varieties from all parts of the world. The result is that, at this time, a large part of the wines exported are either partially or wholly made of foreign grape varieties, and, as a whole, will compare favorably with the product of any European country, while among the choicer kinds now ripening there are some that will take rank with the high-priced fancy brands of France. It is true that so far all California-grown wines are recognizable to experts, a peculiar flavor difficult to define, which has been called "earthy," recalling to mind that of the wines of the Vaud and of some of Burgundy. But this peculiarity remains unperceived by most persons, and is not comparable in intensity to the "foxy" aroma of wines made from the American grape varieties.

Another prominent peculiarity of the California wines is that they are generally of considerable alcoholic strength, as the result of the intense and unremitting sunshine under which they invariably ripen. This is especially the case in the Los Angeles region, whose natural wines are by many, at first blush, thought to be "fortified," since they not only reach the maximum alcoholic strength attainable by fermentation, but even then retain a very perceptible amount of unchanged sugar. This circumstance interferes, of course, with the safe daily and sanitary use of the native wines at home, and explains the fact that as yet a not inconsiderable amount, of French clarets especially, is imported into California for table use by the foreign-born population. This folly (for such it must be considered in this point of view) has already been in a measure remedied by the use of such varieties as the Hungarian "Yinfandel" and others of a more acid and tart character; and it is quite probable that it will be found desirable to limit the time of exposure of the ripe grapes to the sugar-making autumn sun in order to restrict still further the alcoholic strength of some of the wines. Of course, the German and French vintners are difficult to convince that there may be in California too much of the blessed sunshine, every hour of which, in their native climes, adds to the market value of their product. This is but one of

the many points in which the vinicultural practice of California seems susceptible of improvement. We find elsewhere that long experience teaches the vintners of each country how to obtain the best possible results under their particular conditions; and it is not surprising that during the short period of experience had in California, and with the tendency of Spaniards, Portuguese, Italians, French, and Germans to introduce each the practice of his own country under circumstances so different, the best methods and uniformity in quality should not yet have become fixed. What is true of wine-making proper is equally so of the modes of culture. The padres naturally adopted the system of short pruning prevailing in their own country, and the later comers as naturally continued it, and, oddly enough, applied it almost indiscriminately to the other grape varieties brought from Northern France, Germany, and Hungary, in some cases even to the varieties of the native American stock, altogether unused to such summary treatment. The experimental stage in California wine-making is also strikingly evidenced by the great variety of grapes still found in the vineyards of progressive growers, as the result of which we find in the markets and in fairs a most tempting and beautiful display of the grape varieties of all countries; and nothing can be more convincing as regards the peculiar adaptability of the State to this industry than the excellence of most of these often surpassing in this respect the best of their kind in their original homes. Yet we can hardly wonder at this in a climate which allows the currant and the orange to ripen side by side.

Another drawback to the quality of the wines thus far is the tendency of each vine-grower to make his own wines, involving not only an unnecessary multiplication of costly buildings, caskage, &c., but also the unfounded assumption that wine-making is an easy thing and can be managed by any one having a moderate amount of common sense; whereas, on the contrary, the production of the best possible result from a given material requires in this case, as in other manufacturing industries, a very considerable amount of knowledge and good judgment, which can be in some degree replaced by mere practice only in countries where long experience has settled all into a regular routine. The introduction of large wineries, managed by professional experts, (like the magnificent establishment of Buena Vista, near Sonoma Town), has gone far toward redeeming the wines of California from the reproach cast upon them by the hasty marketing of first crude efforts, which has, until lately, caused much of the native product to be sold under foreign labels. They have always possessed at least the merit of being made of the grape pure and simple, ungallized and unpainted, not so much, perhaps, as the result of superior virtue of wine-makers on the Pacific coast as because the superabundance and low price of grapes reduces the temptation to adulterate or "correct" the natural product to a minimum. Even within the last few years some vineyards in the interior have been in part harvested by turning in hogs; and other uses for the surplus product have been sought and found in the making of an excellent sirup by evaporation of the must. The growing appreciation and consequent better price of California wines will probably hereafter prevent recourse to such expedients.

A detailed consideration of the methods of wine-making is beyond the limits of the present article, but it should be said that after the picking of the grapes (usually by Chinese) the means and appliances used in the succeeding processes are generally (as in other branches of agriculture in California) of the most approved and efficient kind, and the operations conducted in the most cleanly manner. The reported tread-

ing of the grapes by the feet of "Greasers" in the southern part of the State applies only to the pommace destined for distillation into brandy; albeit for certain kinds of wine (*e. g.*, Port) the treading process is deemed indispensable in Europe, and, after all, feet can be washed as clean as hands.

Again, there are in California, as elsewhere, regions whose soil and climate favor the development of the highest qualities in wines, while there are others whose product, however abundant, good-looking, and pleasant to the palate when fresh from the vine, will fail, even with the best management, to yield a beverage fit for exportation.

The volcanic soils of the beautiful valleys of Napa and Sonoma have thus far achieved the highest general reputation for wines of fine bouquet; yet even there the products of adjacent vineyards sometimes differ widely, and these differences are not yet, as a rule, sufficiently considered by the producers, or by those who blend the several products for market. The red soils of the foot-hills of the Sierra also give high promise of fine wines, and in the Coast Range those of the valley of San José are noteworthy. The wines made from the sugary berries of Los Angeles are, of course, very similar to those of South France, Spain, and Portugal—fiery, and with a heavy body, but less "bouquet" than those grown farther north. Its least deserving wine (if it may be so classed at all) is perhaps the far-famed Angelica; and the mission grape almost alone is in bearing there as yet.

The vineyards planted on the heavier soils of the Sacramento Plain yield a large part of the table grapes for the home and Eastern markets, and seem destined to become one of the chief regions for the raisin-making industry, to which the climate of the great interior basin is, of course, especially adapted in consequence of its rainless summers and intense, dry heat, sweetening the grape to the utmost and rendering the curing process easy. Owing probably to a combination of favorable soils and good management some of the Muscatel raisins from near Woodland, in Yolo County, have proved fully equal to the highest quality of those imported from Malaga. Unfortunately the commercial standing of California raisins, like that of its wines, has been injured by putting into market such as, from the mode of curing, did not possess the requisite keeping qualities. The efficient drying apparatus now introduced obviates this objection, and it is highly probable that raisin-making will hereafter take its place, alongside of wine-making, among the most important industries of the State.

Brandy-making, also, has not been neglected, but in consequence of unfavorable Federal legislation has until lately labored under great disadvantages. Most of the native "Aguardiente" has been distilled from pommace, and is, of course, rather hot and rank-flavored. In the Los Angeles region it is, to a great extent, the "first run" of the grapes only that is made into wine, no presses being used; hence, the brandy made from the residue is of higher quality. The distillation of brandy from from wine itself (now so rare in France) from the best of foreign grapes has been made a specialty by General H. Naglee, of San José, and the quality of the product is far above that of any imported now in the market. That the extensive importation of grape varieties should result in the introduction of their formidable enemy the *Phylloxera* is not surprising; but we may well wonder at the indifference with which that now well-known fact is regarded by the majority of wine-growers, even in districts in which the insect has already made its appearance and has shown its power for harm. This is due largely to the fortunate, as well as unexpected and hitherto unexplained, circumstance that the progress of the pest has

been remarkably slow as compared with its sweeping advance in Europe, though evidently not less sure. It is as though the winged form were either not produced at all or very much restricted in its powers of locomotion. It, therefore, seems quite possible to check, and perhaps stamp it out by timely precautions. But nothing of the kind has been done, and the penalty of this neglect has already been dearly paid in the Sonoma Valley, the region chiefly afflicted. Sonoma Mountain seems to have proved an effectual barrier against its transmission to the Napa Valley. The ravages of the insect are also reported from some other localities, but no noteworthy damage has thus far been heard of. Of other vine pests, the *Oidium* and a kind of black-knot are the chief; but, on the whole, the damage done has been merely local and easily checked, and it may truthfully be said that to the grape-vine, as to the human race, the climate of California is exceptionally kind.

WATTLE BARK.

(KNOWN IN COMMERCE AS "MIMOSA BARK.")

In January last a board of inquiry was appointed by the colonial council of Victoria, Australia, to consider and report upon the subject of wattle bark, with regard to the indiscriminate stripping of the trees caused by the increasing demand for bark in continental and English markets, in addition to the requirements of Victorian tanners, which might lead to the early extermination of the trees or to a reduction of the supply necessary for the home trade even temporarily. The board was also asked to state whether forest regulations could be so framed as to conserve and encourage the growth of the wattle trees in order that a sufficient supply of bark might be insured for local requirements, as well as for the maintenance of the export trade.

From this report it appears that two of the varieties of the wattle mentioned are extremely valuable, not only for the tanning material they furnish, but for their timber, which can be used for a variety of purposes, and for firewood, which is said to be of the very best description. Their remarkably rapid growth, too, should be taken into consideration as an important element in estimating their worth.

Of the tree known as the wattle in the colony of Victoria, there are three species, all of the genus acacia, from which the bark used in tanning is obtained. These are: *Acacia pycnantha*, commonly known as the "broad-leaf," "golden," and "green" wattle; *Acacia decurrens*, or black wattle; *Acacia dealbata*, or silver wattle. The first named has a thick, glossy ovate leaf, the bark being thinner and smoother than that of either of the others. It is chiefly found in the southwestern part of the colony and along the coast as far as the colony of South Australia. Its bark is generally considered superior to any other, but the habit of the tree is not so advantageous, being of slower growth and not attaining such large dimensions as the black and silver species.

The black wattle is found over all the western district of Victoria, in the northeast, and also in the district of Gippsland. It is of vigorous, robust habit, and for commercial purposes is equal to the broad-leaf species. From the rapidity of its growth, and the ease with which it can be stripped during the proper season, the board considered that, for all practical purposes, it was desirable to cultivate this species either

alone or with the broad-leaf wattle. The silver wattle, for tanning purposes, is generally discarded.

Wattles grow on almost any soil, but their growth is most rapid on loose sandy patches, or where the surface has been broken for agricultural or other purposes. Where the soil is hard or firm it is recommended that plow-furrows should be made at regular distances of five or six feet apart, into which the seed should be dropped. The outer covering of the wattle seed is peculiarly tough—hard and horny in character—thereby forming a protection which renders the seed comparatively impervious to ordinary germinating influences. It will, therefore, be found necessary to employ a more direct agency than simply covering the seeds with earth. Water of a little less than boiling temperature should be poured on them, and they should be allowed to soak until soft. As the seeds are small and ought to be sown near the surface, a very light sprinkling of earth is sufficient. For all practical purposes it would be enough to drop the seeds about one foot apart along the furrows, in which case about 7,200 seeds would suffice for an acre of land. The wattle seed is cheap, and can be bought for 8*s.* or 10*s.* per pound. There are about 40,000 seeds of the black wattle to the pound. Those of the broad-leaf are one-fourth heavier, and consequently there are not more than about 30,000 to the pound. The seeds could, therefore, be dropped more plentifully with little additional expense, and the seedlings thinned out at discretion, thereby increasing the chances of a regular plantation. On loose sandy soil, on which *Acacia pycnantha* can best be raised, it might not be even necessary to break up the soil in any way; but it should be borne in mind that any opening up of the surface would materially accelerate the germination of the seed and subsequent growth of the seedlings. On such open sandy soil the furrow line might be dispensed with and the seeds scattered broadcast. When the young trees attain the height of three or four feet the lower branches should be pruned off, and every effort afterwards made to keep the stems straight and clear, in order to facilitate the stripping and nduce an increase in the yield of bark. In all instances where attention is paid to the cultivation of wattles as a source of income, care should be taken to replace every tree stripped by successional sowings, in order that there should be as little variation in yield as possible.

The wood of the wattle is of considerable value for industrial purposes. It can be readily utilized for cask staves, for axle spokes, for ax and pick handles, and many other articles requiring a tough and durable grain. When dried, it forms the best fire-wood known for culinary and all domestic purposes, also for ovens and furnaces. It emits a clearer and greater heat than other firewood. The wattles may be utilized also for fencing, the trunks making top rails of the best description. The commercial uses of the wattles are multifarious, as, in addition to the value of the bark and the wood, a good profit may be derived from the sale of the gum which exudes from the trees. Recently the price of Australian gum has increased thirty per cent. in the continental and English markets.

The character of the soil appears to affect, to some extent, the quality of the bark, this being clearly proved to the members of the board during their inspection of the North Gippsland district. A sample of bark from trees growing on a limestone formation was greatly inferior in tannin to that of bark obtained from another section of country, although the climate was in every way calculated to produce better results. From bark growing within five miles of the Buchan River 42 per cent. of tan material was obtained, while the bark taken from the lime-

stone formation on both sides of the stream only yielded 29 per cent. Continuing the examination still further, the board found that the samples of bark obtained from the Goulburn and Western districts were about equal in point of tanning strength, both being a little inferior to the best bark obtained from Gippsland. The bark in each instance subjected to analysis was of the black or "feather" leaf species. The bark of the golden leaf or broad leaf wattle was also tested, and the result proved that its strength exceeded all the other barks by fully 5 per cent.

The size of the trees varied considerably in many districts, soil and position evidently effecting the difference. One of the largest black wattles met with in the western district gave a mean diameter of 24 inches, its age being ascertained to be eighteen years. This may be taken as the maximum size attained by this species; and, although even larger trees may be occasionally met with, the wattle is at its prime when about ten years old, and possessing a trunk 9 or 10 inches in diameter. After that the trees lose their healthy, vigorous habit, and are usually attacked by disease and wood insects.

In every district visited the most favorable specimens were selected for experimental purposes, and the following statement, which shows the average size of wattles at the ages mentioned, may be applied to the two different species recommended for cultivation throughout the colony:

Species.	Locality.	Years.	Diameter 3 feet from ground.
Black	Glenisla to Dunkeld (western district)	18	20 inches.
Do	Parish of Bairnsdale (North Gippsland)	20	16 inches.
Do	Tullarook to Yea (Goulburn district)	6	7 inches.
Do	Buchan River (North Gippsland, limestone form)	6	5 inches.
Do	South Gippsland, heavy, rank, forest lands	25	17 inches.
Golden	Wallington, Portarlington, and Queenscliff	9	8 inches.
Do	Avoca and Castlemaine	10	7½ inches.

The following table shows the quantity of tan extractive in 100 parts of bark obtained from the districts mentioned:

Species.	Where from.	Percentage of tan extraction.
Acacia pycnantha, golden or broad leaf	Portarlington, Wallington, and Queenscliff	45
Acacia decurrens, black or feather leaf	North Gippsland	40
Do	Wando, Dale, and Victoria Valley, western district.	34
Do	Goulburn Valley	34
Do	Buchan River, North Gippsland, limestone formation.	29

The percentage represents the extractive matter useful to tanners only.

Most of the tanners who were examined on the point stated that, in their opinion, bark possessed the maximum of tan strength when stripped during the last four months of the year, that being the season when the sap is most active. Independent of the fact that a renewal of the supply of tannin is thereby affected, the fact that the bark is stripped during the summer months and dried under ordinary summer temperature

gives it a greater advantage than the bark stripped and dried during the wet months of winter: the bark being exposed to damp and moisture loses a proportion of its strength; the process of drying being longer facilitates the change of tannic acid into gallic acid, or acids of a similar character—substances of no service in tanning.

Wattle bark, during a year's storage, improves in strength. This seems to arise from the augmentation of catechu-tannic acid through conversion or oxydation of catechuic acid, the latter possessing no tannic properties. Bark exposed to weather, and particularly to moisture, also deteriorates in strength by a change of some of the tannic acid into pyrocatechin or oxyphenic acid, and into phlobaphen.

At the present time there are tracts of Crown lands on which the wattle flourishes luxuriantly, although the soil is so poor as to be practically valueless either for pastoral or agricultural purposes. The board also noticed that many extensive areas of land in the districts specified were leased for grazing purposes at a nominal rent, and it was often on patches most barren of grass or surface vegetation that the finest specimens of wattle trees were met with.

Wherever a bush-fire had passed over the country myriads of young wattle trees sprang up. Wattles also spring up in immense numbers where the surface of the soil has been disturbed; this being established by the appearance of a number of paddocks formerly under cultivation, but allowed to lie fallow for three or four years, being literally covered with wattles of both the species most prized by the tanners. No doubt can exist that the wattles are easy of cultivation and remarkably prolific in the matter of seed. On poor lands the wattles grow as readily as grass; in many instances more so. Cultivation will have the effect of increasing the quantity of bark available for commercial purposes to almost any extent.

The age at which trees may be stripped with the best advantage has been determined at from five to ten years.

So impressed were the members of the board with the value of these trees and the importance of encouraging their culture, that they submitted in their report the following recommendations, based on the result of their personal observations and a careful review of all the evidence taken during the course of their investigations:

That the principle of wattle cultivation should be adopted by the State and also by all local governing bodies having the control of reserves or tracts of unoccupied lands. Wattles should be grown on the main roads, along the lines of railway, and on all lands which are not available for other purposes.

That certain areas of poor land at present lying waste should be reserved from selection (or alienation in any other form), and devoted to the systematic cultivation of wattles; these areas to be surveyed in blocks of, say one thousand acres, and let by tender, as wattle-farms to any persons who should produce evidence of the *bonâ fide* nature of their application; the farms to be let on lease for ten or more years, and on the expiration of the term of lease the land to revert back to the Crown, the lessee to be afforded the first option of re-lease, or to be entitled to compensation for all improvements effected during his tenure.

That the State should also encourage the cultivation of the wattle on selected lands still in a measure under the control of the government. In all cases where a selector should adopt the systematic rearing of wattles on his holding, and produce a certain number of tons of bark per annum, that this should be considered an improvement under the land act.

PROFIT TO BE DERIVED FROM THE SYSTEMATIC CULTIVATION OF WATTLES.

Receipts derivable from a wattle plantation of, say, 100 *acres, planted in the manner proposed.*

Each acre planted with wattles, 10 feet apart, would carry 400 trees; at the end of the fifth year trees would yield, say, 56 pounds matured bark; stripping only every third tree, 333 tons would be obtained from 100 acres; this at £4 per ton would give for first stripping	£1,332 00
In the sixth or following year a similar number of trees would be stripped, the bark having increased in weight, say, 14 pounds; the increased yield of second stripping would, therefore, be 400 tons, at £4 per ton, making	1,600 00
In the seventh year the remaining trees would be stripped, from which a still greater increase would be obtained, say, 480 tons, at £4, making	1,920 00
The aggregate yield of bark during the first eight years would be 1,215 tons.	4,852 00

Estimate of expenditure on a wattle plantation of 100 *acres during eight years.*

Rent of 100 acres for eight years at the rate of 6*s.* per acre per annum	£240 00
Plowing 100 acres in drills 10 feet apart	25 00
Sowing wattles and actual cultivation, including cost of seed	37 10
Supervision for eight years, nominal, say £50 per annum	80 00
Pruning the trees, taking off useless wood, &c. (only necessary for two years), 10*s.* per acre	50 00
Incidental and unforeseen expenses	27 10
Interest on the whole amount expended during the eight years	240 00
Actual cost of stripping and carting *	1,515 00
	2,215 00
Profit balance, exclusive of improvements or supplementary sowings †	£2,637 00

In the United States there is a vast annual consumption of tanning materials, the principal supplies, as will be seen below, being drawn from home resources. It does not appear, however, that any measures have been taken to meet this demand by artificial reproduction.

Mr. Isaac H. Bailey, of New York, editor and proprietor of the Shoe and Leather Reporter, and a gentleman of much experience in all things relating to the manufacture of leather, in reply to a request of the Commissioner of Agriculture that he would furnish him with some information concerning the consumption of tanning materials in the United States and the principal countries of the world, said:

The tanners of the United States use mostly hemlock and oak bark, which averages to cost, say, $5 for hemlock and $9 for oak per cord (2,240 pounds, or one ton, equal in weight to the cord). We estimate they use 1,225,000 cords annually, two-thirds of it being hemlock bark. The hemlock supply comes from Eastern Maine, Northern New York, Northwestern Pennsylvania, Michigan, and Wisconsin; oak bark from the Alleghany, Cumberland, and Blue Ridge ranges of mountains, Southern Kentucky, Tennesse, Northern Georgia, and Alabama.

There are also used here in tanning light leathers about 600 tons gambier and cutch, worth $80 per ton; 10,000 to 12,000 tons domestic sumac, worth $45 per ton, and 8,000 tons Sicily sumac worth $85 per ton.

This is the yearly consumption for this country. Oak and hemlock bark extract is also made and used here, but much of it goes to Europe. Tanners here use about $200,000 worth yearly.

In Canada there is a great deal of hemlock bark grown and used. It is largely made into extract, and sold to Europe; but about 600,000 hides are tanned there, requiring probably some 60,000 cords of bark for doing the work.

The time must be very remote when our tanning material will be exhausted. Oak

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* The cost of stripping would not exceed 15*s.* per ton on account of the facilities presented by the regularity of the trees, while carting would represent another 10*s.* per ton. These combined charges would be 25*s.* per ton, and on 1,215 tons would be £1,515, leaving a clear profit on the 100 acres (after allowing for the primary expenditure) of £2,637.

† In addition to the bark taken off the land a fresh supply would be available in two seasons afterward, as the board recommends that every fresh tree stripped should be replaced by another sowing. All improvements effected may be calculated as additional profit.

trees reproduce themselves; hemlock do not. Possibly, hemlock might give out after another century of tanning. The sumac crop we shall always have.

Statistics of foreign tanning materials are not so easily obtained. In South America oak bark and the wood of the quebracho tree are used in tanning. In Valdivia, Chili, there are about twenty tanners who get out 150,000 sides of leather, mostly sole, yearly, using about 15,000 cords of bark. This Valdivia oak gives a dark color to the leather, and it resembles hemlock tannage. Tanning in other portions of South America is limited. The inhabitants get most of their leather and boots and shoes from Europe.

In Australia, wattle or mimosa bark is used for tanning. It costs there $25 per ton.

Great Britain tans largely for other European nations, as well as for her own requirements. The tanners there employ a variety of materials in their work. They used 22,524 tons of gambier, 28,308 tons of valonia, and 26,000 tons of myrabolams. Of bark for tanning and dyeing purposes they imported 29,091 tons. The prices at date (February, 1879) of these per ton are: Valonia, $75; gambier, $85; myrabolams, $30; English bark, $30; and Dutch and German, $25.

French tanners use almost exclusively oak bark. They consume not far from 500,000 cords annually, most of which is produced in France and Spain, and costs about $32 per cord.

German tanners use oak bark chiefly, which they get in their own country or from Austria. It is worth $25 to $30 there. The leather they tan is all used at home. They export none.

Austria also tans largely, using oak-bark, worth about as above. The leather made is used in shoes and other goods for home use and export.

Gambier is the strongest tanning agent and the most widely used, but in connection with other things. It is used almost exclusively in Asia, the East Indies, and parts of Africa.

The tanning materials in general use by the principal nations of the world are given in the following table, in which is stated the percentage of tannin contained in each:

Substances.	Percentage of tannin.	Authority.
Old oak, white inner bark	21.0	Cadet de Gassincourt.
Do	14.2	Davy.
Young oak, white inner bark	15.2	Do.
Young oak, colored or middle bark	4.0	Do.
Young oak, entire bark	6.0	Davy and Geiger.
Young oak, spring-cut bark	22.0	Do.
Oak kermes, bark of root	8.9	Do.
Bark of red oak (*Quercus rubra*) from Canton, Ill	5.55	William W. McMurtrie. Department of Agriculture, 1876.
Bark of white oak (*Quercus alba*) from Canton, Ill	7.85	Do.
Bark of *Quercus coccinea* from Canton, Ill	7.73	Do.
Bark of *Quercus macrocarpa* from Canton, Ill	7.85	Do.
Bark of hemlock (*Abies canadensis*) from Van Ettenville, N. Y.	9.5	Do.
Bark of hemlock	13.92	Mulligan and Downing.
Crushed Quercitron bark (*Quercus niger*) from Winchester, Va.	6.47	William W. McMurtrie.
Cutch	47.7	Cooper.
Catechu, Bombay	55.0	Davy.
Catechu, Bengal	44.0	Do.
Catechu, Bombay, light color	26.32	Mulligan.
Catechu, Pegu, dark brown color	46.88	Do.
Gambier or terra japonica	44.88	Esenbeik.
Galls, Aleppo	65.88	Guibourt.
Galls, Chinese	69.0	Bley.
Galls, Istrian	24.0	Roder.
Myrabolams	20.91	Mulligan and Downing.
Sumac from Sicily	16.20	Davy.
Sumac from Carolina	5.0	Cadet de Gassincourt.
Sumac from Virginia	10.0	Do.
Do	19.35	G. Muller.
Sumac from Palermo	24.37	Mulligan and Downing.
Sumac, ground, from Winchester, Va. (mixed)	24.18	William W. McMurtrie.
Sumac (*Rhus cotinus*) Hallsborough, Va	24.08	Do.
Sumac (*Rhus glabra*) Georgetown, D. C	26.1	Do.
Valonia from Smyrna	34.78	Mulligan and Downing.
Divi-divi	29.80	Do.
Do	49.25	G. Muller.
Mimosa bark	17.87	Mulligan and Downing.
Do	31.16	G. Muller.
Wattle bark (*Acacia pycnantha*) golden or broad leaf	45.0	Bosisto, of board of inquiry appointed by council of colony of Victoria, Australia.
Wattle bark (*Acacia decurrens*) black or feather leaf	40.0	
Do	34.0	
Do	34.0	
Do	29.0	

The following figures, taken from the American Cyclopædia, showing the percentage of tannin contained in most of the substances mentioned above, cover only the variations found in excellent samples of the same material. The characteristics of each are also given:

Trade name.	Percentage of tannin.	Characteristics.
Terra japonica	42 to 50	Color bad; makes little weight; leather soft and open.
Sumac	24 to 33	Color light; gives some firmness; makes leather soft and pliable.
Myrabolams	28 to 44	Color yellow; makes little weight; leather mellow.
Oak bark	11 to 13	Nearly colorless; gives good weight; makes leather very firm and solid.
Hemlock bark	11 to 13	Color red; gives good weight; makes leather firm and hard.
Valonia	34 to 40	Color fair; gives weight; makes leather hard.
Divi-divi	26 to 50	Color poor; gives great weight.
Mimosa bark	24 to 36	Color very red; gives weight; makes leather hard and brittle.

It will be seen that analyses made of these substances by distinguished chemists vary widely in their results. For this reason, the tables given cannot be depended upon. Intelligent tanners are not, however, guided in their selection of tanning materials by the absolute percentage of tannin alone, but follow rules based on their own experience. The color, general appearance, solidity, pliability, and many other conditions which constitute good leather must be taken into consideration. These depend upon other things than the mere amount of tannin contained in the barks or other substances which are employed, and have, of course, a corresponding influence upon their price.

In the United States and England oak-tanned leather is regarded by many as the best. In this country it always brings a higher price than hemlock-tanned leather, not only because it is supposed to be more durable, but because of its light color. The coloring matter and resin contained in the hemlock have a tendency to make the leather harder and more brittle, and also to make it of a dark reddish hue that is not liked so well as the bright light appearance of that tanned with oak. Another reason for the greater popularity of the oak-tanned leather is that both in the United States and England all supplies for government use are required to be of this tannage.

Gambier, or terra japonica, is extracted from the leaves of the *Uncaria gambir*, a shrub cultivated in the countries lying on both sides of Malacca. It is obtained by boiling the leaves in water and evaporating, then adding a little sago to give it consistency.

Cutch is extracted from the acacia catechu, a tree which grows to the height of twenty or thirty feet on the coast of Malabar. The heart and bark of the wood are boiled in water and the solution evaporated.

Divi-divi is a pod of a shrub a native of South America and the West Indies. The tannin is concentrated in the rind of the pod.

Myrabolams is the commercial name of the dried fruit of the *Moluccanna* imported mainly from the East Indies.

Valonia is the name given in commerce to the acorn cups of the prickly capped oak, *quercus aegilops* which grows abundantly in the Morea and adjacent countries, and also in India.

The results obtained by tanning with valonia are almost if not fully the same as when the best qualities of bark are employed. It makes hard, firm leather, harder and less permeable to water than that made with oak bark, and also presents the advantage of readily depositing a rich bloom upon the leather.

The following table shows the quantities and values of the different tanning materials imported into England during the year 1877:

Articles.	Quantities.	Value.
	Tons.	
Bark (for tanners' and dyers' use)	32, 283	£282, 926
Bark extracts	....	105, 317
Cutch	6, 664	164, 583
Gambier	25, 354	539, 322
Myrabolams	15, 725	203, 042
Sumac	13, 409	224, 862
Valonia	29, 989	668, 497
Total	123, 424	2, 188, 549

In France, in 1875, there were imported 32,261 tons tanning materials of a total value of 10,514,569 francs. Of these, 21,419 tons, worth 4,554,569 francs, were barks for tanners' and dyers' use.

The supplies of bark imported into England and France in the years mentioned were obtained from Algeria, Australia, Austria, Belgium, Germany, Holland, Italy, Norway, Spain, the United States, and other countries.

In 1878 the importations of tanning materials into the United States were:

Articles.	Tons.	Value.
Barks for tanning	....	$412, 575
Hemlock extract	....	24, 214
Cutch, gambier, &c	11, 049	978, 539
Total	11, 049	1, 415, 328

The exports of the same materials from the United States for the same year were of bark of various kinds amounting in value to $111,335.

In 1878, from January to June, 9,871 tons of wattle bark, valued at £73,708, an average of about £7 10*s.* per ton, were exported from the colony of Victoria, against 1,384 tons in 1870, worth then only £4 12*s.* 9*d.* per ton.

In 1877, England imported 12,428 tons of bark, worth £136,944, a little more than £11 per ton, from Australia, all of which was probably wattle or mimosa bark, as it is also called.

This shows a steady and increasing demand for wattle bark and a continued appreciation of its value as a tanning agent. In England the best oak bark is worth $32 per ton, a little more than half the price of wattle bark. It is probable, however, that the difference in price is owing to the superior richness of the wattle in tannic acid, as oak-tanned leather is certainly held in higher estimation in England.

Cutch, gambier, sumac, myrabolams, and some of the barks included in the table showing the imports into England and France, it is proper to say, are also largely used in dyeing.

Exact information with regard to the climate of the colony of Victoria has been furnished by Mr. Robert Ellery, government astronomer at Melbourne, in his report of 1872. The mean annual temperature at Melbourne during fourteen years was 57°.6, and that of the whole province 56°.8, including stations 2,000 feet or 1,400 feet above the sea-level at Daylesford and Ballarat. This is equivalent to the mean annual temperature of Marseilles and Florence, in the northern hemisphere, but the

climate of Melbourne is much more equable than that of the Mediterranean shores. The lowest temperature yet recorded has been 27°, or 5° below the freezing point; the highest, 111° in the shade. At Landhurst, 778 feet above the sea, the greatest extremes of temperature yet observed were 117° and 27°.5. At Ballarat the extreme winter cold was 10° below freezing.

The amount of humidity in the air is liable to great and rapid variations in the summer months. It is sometimes reduced as much as 60 per cent. within a few hours by the effect of hot winds. But this is compensated by an increase of moisture upon a change of wind. The average annual rainfall at Melbourne, which for thirty years is stated at 25.66 inches, does not seem less than that of places in similar latitudes in other parts of the world. Yet it proves inadequate, because of the great amount of evaporation, estimated by Professor Neumayer at 42 inches.

From the foregoing it is almost safe to assume that the climate of a large portion of our Southwestern and Pacific States is peculiarly well suited to the growth of the wattle. There seems to be hardly any doubt that vast stretches of land that are now destitute of trees might in a very few years be covered with a growth of timber, every particle of which, from the bark to the roots, would be most valuable. The lack of rain, which is the principal cause of the absence of timber on most of our prairies, would not interfere with these hardy trees, and it has been demonstrated that the cost of planting them is almost nominal. Although it is not distinctly stated in the report of the board, it is evident that no fences are needed to protect the young wattles from grazing stock. Assuming, therefore, that fences are not necessary, and that wattles may be grown on land actually in use for pastoral purposes, some of the items set down in the board's estimate of the cost of planting may be stricken out and others materially reduced.

The tree arrives at maturity in ten years, and in half that period attains a growth sufficient to make it valuable for many useful purposes. In the treeless sections of our country, therefore, if wattles were grown, even if the bark could not be utilized on the spot, and the wood only could be used in the mechanical arts and as fuel, it would always pay to preserve the bark for exportation, as in England it is worth, according to quality, from £5 to £10 per ton. At points remote from seaports the tannin could readily be extracted and forwarded for shipment in a concentrated form.

FORESTRY OF THE WESTERN STATES AND TERRITORIES.

[The Commissioner of Agriculture is indebted to the courtesy of the War Department for the subjoined report on the forestry interests of some of the Western States and Territories. Believing that such information as could be furnished by the commanding officers stationed at these distant posts would not only prove of great value to persons seeking homes in the West, but would also contain information of much value to those interested in the production and preservation of forest trees,

early in the autumn of 1877 he addressed a letter to the Chief of Engineers, U. S. A., which was responded to as follows:]

HEADQUARTERS DEPARTMENT OF DAKOTA,
Office Chief Engineer, Saint Paul, Minn.

To the CHIEF OF ENGINEERS U. S. A.,
Washington, D. C.:

GENERAL: I have the honor to submit the following report, in compliance with instructions contained in an indorsement upon a copy of a letter to the Chief of Engineers from the Commissioner of Agriculture, which I found in my office upon my return from the field, October 26, 1877.

The following is an extract from the letter referred to above:

* * * "I was advised that I might obtain through your department some valuable information in relation to the forestry of this country, embracing the present extent of the forest area; the lines of drainage; the elevation and rainfall, whether ascertained barometrically or otherwise; the various characteristics of the timber, and the extent, condition, and growth of the principal bodies of timber, especially those bordering upon the plains. I shall esteem it a favor if you will furnish this department, at your convenience, with the information here indicated, as well as any matter of interest connected with the general subject of the forestry of the country.

"Respectfully,

WILLIAM G. LE DUC,
Commissioner of Agriculture."

It is to be seen that the information requested covers a great deal of ground.

To enable me to report as fully as possible, I requested that the following circular-letter be sent from these headquarters:

"(CIRCULAR LETTER.)

HEADQUARTERS DEPARTMENT OF DAKOTA,
Saint Paul, Minn., November 8, 1877.

"COMMANDING OFFICER (each post in Department of Dakota, excepting Fort Snelling):

"SIR: The commanding general directs that as soon as possible after the receipt hereof you send to these headquarters as full a report as possible upon the reservation of your post and adjacent country in respect to the following points, viz:

"1st. The present extent of the forest area.

"2d. The lines of natural drainage.

"3d. The elevation, whether ascertained barometrically or otherwise, and the rainfall; and the manner in which both have been ascertained.

"4th. The various characteristics of the timber, and the extent, condition, and growth of such timber, together with any information of interest connected with the general subject of the forestry of the country.

"5th. The rate of decrease in the amount of timber, and the cause of such decrease, as, for instance, by fire, or through the agency of man.

"6th. Whether the planting of trees has been resorted to, and, if so, whether by shoots or transplanting, and with what success.

"To enable you to comply with these instructions, you will call, if necessary, upon the post-surgeon or other officers of your command for subreports upon the points hereinabove enumerated.

"I am, sir, very respectfully, your obedient servant,

GEO. D. RUGGLES,
Assistant Adjutant General."

The request was kindly complied with, and the reports have now all been received and referred to me. A report from Fort Snelling was not asked for.

The reports of Lieut. Col. Daniel Huston, jr., Sixth Infantry, commanding Fort Buford; of Lieut. Col. William P. Carlin, Seventeenth Infantry, commanding Standing Rock; and of Assistant Surgeon Blair D. Taylor, U. S. A., post surgeon, Fort Rice, will be found of more than ordinary interest, and attention is specially invited to them.

REPORT.

Dakota, lying west of the Red River of the North, and bisected diagonally by the Missouri, is embraced between parallels 41° 40′ and 49° north latitude and 96° 25′ and 104° longitude west from Greenwich; its

greatest length is 414 miles, and its greatest width 360 miles, thus having an area of 150,932 square miles, or 96,595,840 acres, including a detached portion of 2,000 square miles lying west of Wyoming Territory.

The Missouri River traverses nearly the whole Territory from northwest to southeast, and with its many tributaries drains the greater portion of the Territory. The Red River of the North forms the eastern boundary for two hundred miles. It has numerous tributaries in Dakota, but with the exception of the Pembina, which drains the northeastern portion of the Territory, they are mostly small. The only other large streams not connected with the Missouri are the Mouse, or Souris, an inlet or tributary of Souris Lake, and the stream which connects Turtle Lake with Devil's Lake.

The Territory of Montana, which lies about midway between the Great Lakes and the Pacific Ocean, is embraced between 45° and 49° of north latitude, and 104° and 115° longitude west from Greenwich. It is about 276 miles wide and a little over 520 miles long, and contains 143,776 square miles. The lines of drainage are as follows:

1. The Missouri, with its numerous tributaries, the most important of which are the Milk, Marias, Judith, Muscleshell, Madison, Gallatin, and Jefferson Rivers.
2. The Yellowstone and tributaries, of which latter the Big Horn, Tongue, and Powder are the most important.
3. Clark's Fork of the Columbia (connecting Flathead Lake with the Lake Pend D'Orcilles in Idaho), with its tributaries.
4. The Koolanie River in the northwest corner of the Territory.

Mr. Thomas P. Roberts estimates the area of the basin of the Missouri above the mouth of the Yellowstone to be about 93,300 square miles, and the area of the Yellowstone basin to be 78,750 square miles.

Nearly the entire surface of Dakota and a large portion of Montana are composed of plateaus of greater or less elevation.

In the southeastern portion of Dakota there is a range of high lands called the Coteau des Prairies. Its greatest elevation is 2,046 feet above the sea. West of this is another range called the Coteau de Missouri, which extends to the Missouri River. These two plateaus are separated by the valley of the Dakota or James River. North of the Coteau des Prairies extends the valley of the Red River of the North, which is about forty or fifty miles in width, and sloping to the north from an elevation of about 1,100 feet at Breckenridge to 787 feet at Pembina. West of the Missouri the country gradually rises and culminates in the Black Hills and other outlaying ranges of the Rocky Mountains or foot-hills.

Between the Big Cheyenne and White Rivers is a large tract extending into Nebraska, known as the Mauvaises Terres or Bad Lands.

For a more detailed description of the country it may be said that both Dakota and Montana are divided into—

1. The bottom lands.
2. The plateaus or prairies.
3. The mountains or hills.
4. The Bad Lands.

The Red River of the North has no bottom-land proper, the basin consisting of open, grassy plains, which slope gradually down from the highlands.

All of the other streams, except in the mountainous region, are bordered with bottom-lands, varying greatly in extent from the broad lands of the Missouri and Yellowstone to the narrow strips along the smaller creeks. These bottoms are separated from the plateaus above by

abrupt, steep slopes or bluffs of varying height. In the term bottom-lands are included the numerous islands found in the principal streams. These bottoms vary much from year to year, being (especially on the Missouri) washed away at one point to be deposited at another. Islands form continually in those portions of the river which are bordered by the low alluvial lands, and the island once formed it is, in the course of a short time, covered with a growth of willows and afterward of cotton-wood. It is almost exclusively in these lands and in the coulisse or ravines running down to them from the plateaus that the cottonwood is to be found. All of the streams are more or less fringed with it, but it is seldom that the fringe is more than a few hundred yards in width. For a large portion of Montana and a still larger portion of Dakota cottonwood is the only timber, and it is, as stated above, found only in the bottom-lands and ravines. Occasionally a few other varieties of trees are found, but they are invariably of small growth. The cotton-wood is hardy, and will grow on almost any soil, provided there be a sufficiency of moisture and it be protected in its infancy from strong winds. It is of very rapid growth, and varies greatly in size. The largest varieties which I have seen are about eighty feet in height, with a trunk about three feet in diameter.

During the winter the Indian ponies subsist on the bark of the young trees, and I understand that the more hardy class of our cavalry horses can "get through" the winter on it. The wood is tough and strong, with a good grain, but full of sap, and it warps readily and quickly when converted into boards. I understand, also, that in dwellings constructed of it bed-bugs make their appearance in great numbers at an early date. These defects could probably be remedied by a good and thorough process of seasoning. Still, it is doubtful if the cottonwood will ever to any extent be used for timber. It must, probably, be content to serve its purposes as fuel, for shade, and to furnish material for the log houses of the military and civil pioneers.

The valley of the Red River of the North and most of the lakes have their growth of hard-wood trees, oak, hickory, birch, beech, maple, &c. The timber of the river grows only in the alternate bends, and the fringes around the lakes are not of great width.

The high winds and fires which prevail on the plateaus have caused these latter to remain treeless. It is only in the bottoms or ravines that a sufficiency of moisture and protection from fires and winds attains, and consequently only there are the trees found. But in the mountainous or hilly regions it is different. Here the streams running between high, abrupt bluffs have no timber, while the hills, as a rule, are covered with a comparatively thick growth of pine, cedar, spruce, and fir. The Black Hills and the smaller ranges, such as Slim Buttes, Short Pine Hills, &c., have all a growth of the above-mentioned trees, and that of the Black Hills and neighborhood is very fine.

Passing into Montana, the hills occur in greater frequency and of greater extent.

Mr. George Clendennin, jr., who has traveled over the greater portion of Montana, estimates that from 110° to 112° longitude the mountainous area is about one-third, and west of 112° it was fully one-half. This mountainous region is thickly covered with pine, spruce, fir, &c. The pine, which is of the straight, resinous, yellow variety, ranges as high as two and a half feet in diameter, but is suitable, generally, for common lumber only.

Along the Muscleshell, from the Big Bend to the Missouri, belts of good, straight cottonwood about three hundred yards in width are

found. Above the Big Bend the cottonwood is scrubby and straggling. The growth of cottonwood on Milk River is greater than on the Muscleshell. Along the Missouri, from Cow Island to a short distance above the mouth of the Judith, the hills are covered with pine. From the latter point to Benton only a few patches of cottonwood are found, and no other timber, except back on the mountains.

On a great many of the small streams in the mountainous regions more or less of box-elder is to be found, but it is of small size and of no value. It is very difficult to make it burn. The amount of timber does not seem to vary from year to year.

No timber is found in the Bad Lands.

The rainfall throughout the two Territories does not usually exceed 20 inches.

PLANTING OF TREES.

The planting of trees has received attention at but few of the military posts in this department.

The farmers of Dakota have, however, paid considerable attention to this subject, and I understand have been generally successful, and I believe, from the information which I have been able to procure, that trees of all the ordinary varieties can be grown with success and profit throughout the Territories.

Attention is invited to what Colonel Carlin says in his report in reference to this subject.

Fruit trees have been planted in the Bitter Root Valley of Montana with complete success.

Mr. James B. Power, general land-agent of the Northern Pacific Railroad, has kindly furnished me with the following information:

In the nursery at Castleton there were planted, in 1874—

Box-elders, from seed.—Four feet high after four years' growth.

White willow, from cuttings.—Ten feet high after four years' growth.

Cottonwood, from cuttings.—Ten to fourteen feet high after four years' growth.

Lombard poplars, from cuttings.—About six feet high after four years' growth. These were frozen down twice.

White ash, from seed.—Six inches high after one year's growth.

Soft maple, from seed.—Four to six feet high after four years' growth.

For successful growth the ground should be prepared as for wheat; plant the second season, after breaking ground. During the growing season the trees should receive a cultivation similar to that given to corn. This cultivation, with ordinary care, will make the trees self-sustaining at the end of four years. The trees were planted in rows of 10 feet apart, and with a distance of two feet between the trees of each row. The object in planting them so thickly was to make them grow tall, as is shown by the fact that in dense forests the trees are, as a general rule, tall and spindling. By being near together they aid each other's growth in keeping up the moisture. One great secret of causing them to grow tall is to trim them, since all plants have a tendency to spread out near the ground, and by trimming, the substance, which would otherwise be taken up by the spreading branches, is kept in the main stem, which increases in height.

The cost of preparing the ground and transplanting has been about $25 per thousand trees along the Northern Pacific Railroad.

The loss of trees in cases where seed were used has been nothing, while the loss from cuttings has been about 50 per cent. The summer winds seem to dry up the tops of the cuttings, but this fault is local to the near neighborhood of the Northern Pacific, as in Southern Dakota great success has been met with in the use of cuttings. The farmers in this latter section recommend planting the cuttings rentirely under ground. Black walnuts have been grown very successfully along the line of the road. Mr. Power says that, as a general rule, the planting of trees on the western prairies has succeeded admirably.

Judge C. E. Whiting, of Whiting, Iowa, says that timber can be grown upon all of our prairies easily and with absolute success, and that there is a cost value in every tree planted. The judge has had such great suc-

cess with his timber that, although his residence is not in this department, still the following replies to my questions are inserted as showing what can be done in this Western country:

Question. How far and in what direction is Whiting from Sioux City?

Answer. I am 26 miles south by 12 east from Sioux City, in the center of the Missouri bottom, here some twenty miles wide on the Iowa side.

Question. Are the climate, soil, and general features of the country about the same as in the neighborhood of Yankton or Southern Dakota? Please give the general characteristics of the climate as to rainfall (the months in which the fall is greatest), the amount of winds, length of winter, &c.

Answer. Our climate, soil, and productions differ much more from those of Yankton than the distance would indicate. Our average rainfall is from 35 to 40 inches, but much more during the last three years. Our winds are strong, but no worse than in any open country. Frost usually kills vegetation from the first to the middle of October, but we usually have no real winter till December. Our cattle go to grass from the 20th of April to the 10th of May.

Question. What varieties of trees have you planted, the number of years they have been growing, and their average size; the number of trees?

Answer. I have planted the cottonwood, hard and soft maple, black and white walnut, white willow, ash, locust, mulberry, elm, larch, and many kinds of evergreens and other trees. They are of all ages from one to sixteen years, and of all sizes up to two feet in diameter and seventy feet in height. I have some forty-five acres planted, all in belts around my fields, from one to twenty rows wide, numbering 25,000 cottonwoods, 20,000 white or soft maples, 75,000 black walnuts, and a large number of other trees.

Question. Have you made use of seed and shoots, or have you resorted to transplanting?

Answer. I raise all my cottonwood from young plants from the Missouri bars, where they are found by the million. They grow well from cuttings, but it is more work. Walnuts, maples, box-elders, elms, and ash I raise from seed, and white willows from cuttings. Evergreens I transplant from the nurseries.

Question. Please state what success you have had with each of these processes, and which you prefer, with reasons therefor.

Answer. With all our native trees, including the white willow, my success has been complete. I take the cottonwoods from the bars because it is the least work, and when set with ordinary care they all live. For the same reason I use cuttings of the white willow. Of the other trees named I plant the seed, because it saves me more than four-fifths of the work, and with many varieties at least two years' growth, notably so with the black walnut.

Question. What is your method of cultivating the trees? Do you ditch around the young trees, and do you pay especial attention to irrigation? In transplanting do you cut off the branches close to the trunk, or do you cut off the trunk below the branches?

Answer. I cultivate all my trees for the first two years, and if not too large a little in the spring of the third year, just as I would a crop of corn that I wished to make yield eighty bushels to the acre, using my double cultivators the first two years unless the trees become too large. I have my ground in good condition and pay no attention to irrigation, and about as little to the branches.

Question. About what percentage of the trees mature?

Answer. In all my later plantings I have put my rows 6 feet apart and 2 feet in the rows, making four thousand three hundred and fifty-six trees to the acre, and they so nearly all grow that the percentage of loss is not worth naming.

Question. Do you think that better results in planting trees are obtained in a settled section than in a wild one, other things being equal?

Answer. I have planted most of my timber after the prairie was broken and one crop raised on the land. The richness of land being the same I should expect equal results in both cases.

Question. Since you have lived in Iowa has there been any decided increase in the amount of rainfall; and, if so, do you think that the planting of trees has had any effect in that way?

Answer. The rainfall with us has been greater for a few years past, but I am not prepared to say that it is owing to the amount of timber that we have planted. In many sections we have enough planted to make a very marked difference in the effect of the winds, and from two to five degrees of cold as marked by the thermometer.

It will be seen from the above that Judge Whiting pays no attention to irrigation. That is doubtless because, being in the bottom land and the rainfall so great, there is a sufficiency of moisture. But it would

seem that a careful attention to the irrigation of the young trees on the more northern plateaus, where the rainfall and moisture are much less in amount, must be a *sine qua non.*

Assistant Surgeon V. Harard, U. S. A., in a botanical report submitted to me, says:

In closing, I wish briefly to state my views in regard to the much-discussed subject of the treelessness of the western prairies, having had abundant opportunities during the past summer to verify the correctness of the various theories advanced. In the first place, the soil of these prairies, being mostly alluvial, does not originally contain tree seeds, and no spontaneous arborescent growth need be expected simply in upturning it. When such seeds are planted, either by human or natural agencies, the nature of the soil and climatic conditions being generally favorable, they germinate, but as the young stem issues from the ground it becomes the prey of adverse circumstances, which prove fatal to its further development. These adverse circumstances may be several, but the main and all-important one is the prairie fires which every fall and spring sweep over immense areas, leaving no vestige of vegetable life above the blackened ground. Grasses and all annual plants may not be injured; their roots remain mostly intact, and they issue from their ashes as green and vigorous as ever in the spring. Not so with trees and all perennials; endowed with a higher organization, the loss of their limbs is severely felt by the roots; these, affording more substantial food to the fire, are also more deeply burned than in the case of grasses. It follows that whenever a prairie fire visits outlying groves of ash, box-elder, or poplar, the loss is but very slowly repaired, and after their charred remains become surrounded by a growth of young shoots a second visitation will probably extinguish their remnant of vitality.

When trees are protected from fires, especially during the first few years, they grow and generally do well; even when shaken by winds and starved by drought their gnarled and stunted trunks will yet obtain a medium size. Such protection is afforded on bottom-lands from their position and from the moisture of the soil; also in the ravines, which drain the bluffs and open on the valley bottoms. In these ravines the capacity of the soil and climate to produce trees is clearly illustrated. The prairie fire, fanned by the breeze, advances rapidly over the open plateaus; a change of wind will divert its course, but not put it out; the moment it reaches the edge of a ravine it seems to hesitate, advances slowly, and soon, no longer fed by the breeze, which is unable to reach it, dies out. In consequence such ravines are well wooded. Traveling along the Missouri or Yellowstone one sees large areas of level country totally stripped by fire, then depressions with white grass and brush, and again deep ravines and gorges with grass, brush, and groves of trees.

These considerations contain practical suggestions for tree culture. It is impossible to prevent prairie fires, and laborious as well as expensive to protect any place from them in the open plains. Therefore it seems logical to seek such places for plantations as are naturally protected, and we generally find them in the Bad Lands. The Bad Lands, or at least most of them, are, I believe, susceptible of producing trees. Their suggestive name does not refer as much to the nature of the soil, which is often excellent, as to their irregular, broken, chaotic aspect, and the obstacles which they presented to the march of the hardy Canadian voyagers who first explored them. I am of opinion that the Bad Lands offer very favorable conditions for the successful culture of such trees as grow spontaneously on or near the plains, such as pine, fir, red cedar, ash, box-elder, elm, quaking asp, willow-leaved poplar, alder, and birch.

While agreeing with Dr. Harard that prairie fires are a very great cause of the treelessness of the western plateaus, still those very winds which fan the fires into their immense extent, also, in the absence of fire, sweep over the prairies and cause a rapid evaporation of the moisture (this latter being an essential for the growth of trees), and the amount of rainfall is not sufficient throughout the year to contend against this evaporation. It may be that turning the soil would somewhat diminish the evaporation.

In May, 1876, the rainfall was so great for three days that the expedition against hostile Sioux was delayed in its march. The morning after the rain ceased the column started, and I was amazed to see the condition of the plateau above Fort Lincoln. The soil was to all appearance dry and crumbly. This must have been due to a very rapid evaporation, for a large amount of rain fell, and I conclude that the wind was an effective agent in quickening the evaporation.

Again, the winter winds blow the snow into the coulisse and breaks, and the plateaus are left bare, thus losing a quantity of moisture. It is seldom that there is any sleighing on these plateaus. Therefore it is that in planting trees on the prairie I consider irrigation to be essential.

I cannot agree with the doctor in his opinion of the Bad Lands. The Bad Lands proper have no signs of vegetation, and even if the soil were good (which I do not agree to), I believe that from the very nature of the formation of these lands it would be impossible to grow trees in them. Still that is an open question, and the doctor may be right.

DAKOTA TERRITORY.

FORT SISSETON.

Latitude 45° 39′ 20″, longitude 97° 30′, situated on the Coteau des Prairies, about forty miles east of James River. The surrounding country is a high rolling prairie, interspersed with many lakes whose margins are very sparsely timbered with scrub-oak, water-elm, lime, and cottonwood. No streams in the vicinity; no dews; mean annual temperature 38°. The timber of the Coteau consists of oak, sugar-maple, ash, and box-elder. Captain J. H. Patterson, 20th Infantry, reports:

The growing timber throughout this section of country is on the margin of lakes, of which the number is legion, and at the foot of the Coteau, particularly on the north and west sides. The south and east sides of lakes appear to be the most favorable to the production of timber, though wherever the situation of adjoining lakes or other physical features serve to turn the fire from the timber on adjacent lakes, timber can be found. The ravines running off the Coteau, however, are well wooded, though at no point in quantity to be dignified by the name of forests.

Some hard or sugar maples are found near the foot of the ravines. The ravines are from one-half to one and one-half miles in length. The timber on the north and northeastern slopes of the Coteau may be safely estimated at fifteen thousand to twenty thousand cords of hard-body wood.

I give below annual mean of rainfall for 1874, 1875, 1876, and 1877 to date. I divide each year into periods of six months each, commencing with January 1, 1874. I also give, as being of interest, the month in each year in which the greatest precipitation has been observed. The rainfall ascertained by standard rain-gauge:

	Inches.
1874.—First six months	16.13
Second six months	10.72
Total for year	26.85
1875.—First six months	9.90
Second six months	10.20
Total for year	20.10
1876.—First six months	7.40
Second six months	12.54
Total for year	19.94
1877.—First six months	11.62
Remainder year to November 18	7.42
Total up to November 18	19.04

Months in which greatest precipitation has been observed:

	Inches.
June, 1874	5.56
August, 1875	4.16
August, 1876	4.86
June, 1877	4.50

The planting of trees has been resorted to at this post, but without success. The experiment has been continued off and on for the past seven years. The want of success is due, I think, to several causes, among them the absence of proper soil to support tree life, and the unnatural exposure of trees removed from sheltered places to exposed points on the parade grounds.

FORT TOTTEN.

Latitude 47° 59′ 06″, longitude 99° (on the southeastern shore of Devil's Lake). The surrounding country is elevated prairie. Winter usually sets in with November and continues to the end of March, the thermometer often reaching 40° below zero.

Captain A. A. HARBACH, Twentieth Infantry, in his report states:

Nearly all of the forest area within a radius of thirty miles lies contiguous to Devil's Lake, and is estimated at ninety-four square miles, or sixty thousand one hundred and sixty acres. The forest area on the north shore of the lake (including that portion commonly spoken of as the islands) is estimated at fifteen square miles, or nine thousand six hundred acres. The remainder lies south of the lake and north of the Cheyenne River, and is included in Indian and military reservations.

Altitude 1,480 feet; not known how determined, but supposed to have been ascertained by some surveying party. Average rainfall for the past six years, 17.07 inches (ascertained by means of rain-gauge).

The great bulk of the timber is oak, of the variety known as burr-oak, and commonly described as openings. Ash is next in importance as regards quantity and value. In addition to the oak and ash there are in small quantities basswood, poplar, balm of Gilead, elm, willow, and a variety of soft maple. But few good saw-logs are to be had, owing to the scrubby character of the timber. The oak makes excellent fuel when care is taken to procure body-wood.

It is believed that during the past few years the production has equaled the consumption. On the north of the lake fires make their yearly inroads, and it is probable that there is a steady decrease in the timber area. South of the lake fires have been kept out by the Indians, who have not only their cabins and fenced clearings to protect, but their winter grazing grounds.

The estimated consumption is as follows: Fire-wood, 6,000 cords; lumber, 50,000 feet; logs used in construction of cabins, &c., 2,000.

Against this destruction we have the growth from a protected area of seventy-eight square miles, or fifty thousand acres, which is believed to be a full compensation. No planting has been resorted to, with the exception of a limited number of trees on parade ground. Under favorable circumstances there is no difficulty in growing the elm, soft maple, balm of Gilead, or willows.

FORT PEMBINA.

Latitude, 48° 56′ 46″; longitude, 97° 12′ 30″; on the left bank of the Red River of the North.

The surrounding country for thirty miles is flat and low and well watered. Winter sets in with November and lasts until about the middle of April. The elevation is 787 feet, determined barometrically. The average annual rainfall from November 1, 1871, to November 1, 1877, was 16.65 inches, measured by rain-gauge.

Lieutenant PAUL HARWOOD, Twentieth Infantry, reports as follows:

The present forest area upon the reservation is about four hundred and fifty acres, and what remains of its former extent is indifferent and valueless, not only for fuel, but for building purposes. * * * The timber that remains is cotton, elm, bass, maple, and a little poplar, together with a comparatively thick underbrush of hazel and willows.

The water by rain and snow, it is safe to say, is absorbed in a great measure by the ground, although there are in this vicinity "coulisses" that during the wet season carry off to the river more or less of the water that accumulates in the spring from melted snow, but generally the rain that falls during the spring and summer months is absorbed by the soil, which is a rich black loam to the depth of fifteen or eighteen inches. * * *

The timber is confined to the vicinity and banks of the rivers, viz., Red, Tongue and Pembina, the latter river possessing, I imagine, the greatest area of forestry, and where it grows to a great height and size. No pine is obtained, as far as I know, in this vicinity, the nearest pinery being in the valley of the Rosseau River, on the Canadian side of the line, about forty-five or fifty miles east by north from this point. * * *

The timber all around this section of the country, that is, the valuable portion, such as oak and ash, is gradually disappearing; it is done through the agency of man. * * * The decrease of timber by fire is slight.

The planting of trees has been resorted to this side of the line only in one instance, by Mr. A. W. Stiles, post-trader at this post, who last spring planted about one pound of maple-seed, and has met with the most encouraging success. I am told that on the Canadian side of the line tree-planting has been resorted to by several persons, and also the prospects for success are most flattering. The planting is done by shoots or cuttings, and thrives most remarkably.

The transplanting of trees is not practiced, and the experience we have had at this post would not be encouraging to the adoption of it. The storms of winter and high winds that prevail at certain seasons destroy them, and to grow them requires the greatest care and attention.

FORT RANDALL.

Latitude, 43° 01′; longitude, 90° 33′; on the right bank of the Missouri. Timber is found only on the islands and river bottoms; it consists principally of cottonwood and elm. Average temperature, about 47°.

LOWER BRULE AGENCY.

Latitude, 43° 57′; longitude, 99° 21′. On the right bank of the Missouri. The rainfall for the year 1876, as ascertained by gauge, was 16.29 inches. The largest fall generally occurs in June and September. The elevation is about fourteen hundred feet.

Captain I. D. De Russey, First Infantry, says:

The present extent of forest area is comprised in short and narrow belts, confined in close proximity to the Missouri River, on bottom-lands and islands of sedimentary formation, the results of overflow and change of course of the river. It is my opinion that if the timber could be in a continuous belt along the river it would not be over twenty feet in width. The main tributaries of the river are scarcely fringed, and if in a continuous belt would not be over 10 feet in width. The timber consists principally of cottonwood, with occasionally small clusters of ash and burr-oak. The growth of the cottonwood is rapid, the trees often obtaining a diameter at the base of 36 inches. When green it burns indifferently, and when dry it burns very rapidly, supplying a minimum amount of heat. No timber exists away from the river or its tributaries.

In the last three years, in my opinion, the amount of timber has decreased one-fourth, having been used principally by the troops and steamboats plying the river for fuel. Some is also used by the Indian agencies and troops for building purposes. The Indians and their large herds of ponies destroy a great part of the young growth of the cottonwood timber. * * On the tributaries, White Earth River, American Creek, Yellow Medicine, &c., much timber has been destroyed by prairie fires.

No trees have been planted. I believe, however, that transplanting would be successful. The young trees would at first require support and protection against the strong winds and liberal irrigation.

FORT SULLY.

Latitude, 44° 37′; longitude, 100° 36′. On the left bank of the Missouri River. The range of temperature is very great, from 106° in summer to 40° below zero in winter. Rainfall, as determined by established gauge, from January 1 to October 31, 1877, was 13.22 inches, and the snowfall for the same period was 3.02 inches. The elevation is 1,678 feet, but it is not known how it was determined.

Major H. M. LAZELLE, First Infantry, says:

The present extent of forest area of this reservation (forty-two square miles) available for wood does not exceed fifty acres, and for useful timber it is nothing.

First Lieutenant JOHN HAMILTON, First Infantry, says:

The forest area of the military reservation of this post and the surrounding country, is almost entirely limited to a small strip of timber running along the bank of the Missouri River, composed chiefly of cottonwood with a small sprinkling of willow,

box-elder, elm, and ash, except on the Wakibozo Creek, about eight miles southeast of this post, and running in a northeasterly direction from the river. This creek is very sparsely timbered with scrub oak and willow, which have all nearly disappeared within a short time, it being cut off for fire-wood to supply fuel in the post, under contract.

The various kinds of timber with the exception of the cottonwood, are dwarfish and scrubby, and unfit for any use except fuel.

The transplanting of young cottonwood trees has been resorted to within the limits of the post during the past two years only, with partial success, owing, it is thought, to the high elevation of the post above the river, the growth of cottonwood being confined principally to the low bottoms. The trial, however, has not been altogether unsuccessful, great pains having been taken to supply the young trees with a liberal supply of water during the dry summer weather; consequently a fair proportion of those transplanted are now in a healthy and thriving condition.

CHEYENNE AGENCY.

Situated on the right bank of the Missouri River, about seven miles above Fort Sully.

Colonel W. H. WOOD, Eleventh Infantry, says that the timber of the whole section of the country adjacent to the post is confined to the river bottoms. It is principally cottonwood. "Small quantities of oak, ash, elm, and cedar, are occasionally found. The only wood which grows to a size fit for building purposes is cottonwood. The other varieties generally found along the tributaries are of a stunted growth."

Lieutenant R. W. HOYT, Eleventh Infantry, adds to the above-mentioned varieties willow, wild plum, and wild cherry, but says they are very limited in amount and of stunted growth. He further says:

If all the forest area within fifty miles of this post were consolidated I should say there would be less than ten square miles. The timber in the vicinity of this post has decreased about one-half in amount during the last sixteen months. The increasing demand for wood is the occasion of such rapid consumption.

First Lieutenant IRA QUIMBY, Eleventh Infantry, says:

The decrease of timber is rapid; it is cut and consumed by Indians and is furnished by them through contractors to military posts and to agencies. It is also used for building purposes. So great is the consumption and the supply so small that in a few years there will be no timber in the country within twenty-five miles of this post.

STANDING ROCK AGENCY.

Colonel W. P. CARLIN, Lieutenant-Colonel Seventeenth Infantry, says:

There is no military reservation at this post, it being located on the reservation of the Sioux Indians, the limits of which are defined by treaty and executive orders, which, for the purpose of this report, need not be cited.

1st. The present extent of the forest area. The forest area, strictly speaking, is confined to the lowest bottom-lands along both banks of the Missouri River, and narrow fringes of timber along either bank of the streams running into the Missouri from the east and west. The principal streams running from the east into the Missouri, beginning near the north end of the reservation, are Beaver Creek, Hermaphrodite Creek, and a few other small creeks not known by name except to the Indians. These streams are all short and have but little timber along their banks. On the west side of the Missouri River there are numerous tributaries of considerable magnitude and traversing a country at least one hundred miles wide, besides numerous small creeks running from the high lands nearest the Missouri across the bench lands into the river. And again the tributaries of the Missouri have numerous creeks tributary to them, running generally from the northwest and southwest. Nearly all those streams have more or less wood along their banks.

The principal tributaries of the Missouri on the west side are the Cannon Ball, Owl Creek, Grand River, and Cheyenne River, the forks of the latter embracing the Black Hills. Porcupine Creek, four miles north of this post, is also a fine little stream with some timber along its banks.

In the ravines back from the bench lands of the Missouri, in the sheltered places

along hill-sides, and indeed wherever the ground is protected by water, rock, or other natural features, from the prairie fires and fierce northwest winds, are formed strips or clumps of oak trees and occasionally cottonwood. At some points considerable quantities of oak are found in the more rugged and sheltered localities. It is generally of a scrubby character, short in the trunk, and knotty.

As the forest land along the Missouri River is constantly being washed away by the stream, and is of very irregular form, it is impossible to approximate the area, but I will guess at it so far as I have observed it within five miles of this post.

North of the post as far as Porcupine Creek, and on the west bank, there is a body of timber containing about one thousand acres. South of the post on the west bank, and extending four miles southward, is a body containing about two thousand acres. On the east bank at several points within four miles of the post are perhaps one thousand acres. Total, four thousand acres within five miles of the post. Timber land is distributed in about the same proportion along the river from Fort A. Lincoln down to Grand River. There are, probably, forty thousand acres of forest land along the banks of the Missouri River. Below Grand River I think the quantity of timber diminishes rapidly in consequence of the more barren and alkaline character of the soil. Of course the greater part of the timber near this post has been cut away for fuel, building purposes, and for browsing the ponies of the Indians prior to the seizure of these animals.

2d. The lines of natural drainage. The Missouri River drains the country from north to south, and the tributaries named above drain it from west to east and from east to west.

3d. Elevation, whether ascertained barometrically or otherwise, and the rainfall, and the manner in which both have been ascertained. This post has never been furnished with instruments for ascertaining the elevation or the rainfall. The elevation is probably a little less than that of Fort Rice, which is reported at twenty-two hundred feet above sea-level. The rainfall has been sufficient for gardening purposes, and to produce a most wonderful growth of grass during the present year. The streams have also continued to flow all summer and to the present time, showing a sufficiency of rain for all practical purposes.

4th. The various characteristics of the timber, and the extent, condition, and growth of such timber, together with any information of interest connected with the general subject of the forestry of the country. Cottonwood is the principal growth in the forests of this region, both along the Missouri River and its tributaries. There is also a considerable quantity of elm, ash, box-elder, willow, and oak. There is also a valuable shrub, the bull or buffalo berry, which produces a scarlet berry resembling the red currant. This berry is acid in taste and is valuable for food and for making vinegar, wine, and jelly. The tree is heavily armed with sharp thorns, for which reason I think it would be valuable for hedges. Plum trees also grow in this region of country, generally along the edges of bluffs and near the small and shallow streams back from the river. To the westward of this post and near the Black Hills cedar grows in considerable quantities.

The country in this vicinity is well watered. There is a great proportion of rich land, covered with the finest of grasses. Timber grows wherever it can find a secure footing. There are indications everywhere that all this region was once covered with timber. Pieces of petrified wood are found everywhere, and occasionally petrified stumps and logs. In my opinion, protection of the country from prairie fires is all that is necessary to reclothe the whole country with trees. Of course, settlement and the consequent plowing of the land and making roads is the surest way of increasing the growth of forest trees, as the plowed land and roads check the spread of fire.

5th. The rate of decrease in the amount of timber, and the cause of such decrease, as, for instance, by fire or through the agency of man: Near this post and agency, and near other posts and agencies, and at wood-yards along the Missouri River, timber has decreased at nearly the rate of one-fourth per annum, through the agency of man, that is, by cutting wood for fuel for posts and steamboats, and for building purposes.

Within five miles of this post there are probably not trees enough remaining to supply this post and agency with fuel for another year after the present, say three thousand cords of wood. Of course, young trees are growing all the time, but near posts they do not grow fast enough to supply the waste or destruction of old trees. Another cause of the decrease of the quantity of timber is the constant washing away of the woodland and trees in the spring and summer months by the action of the Missouri River. This cause probably decreases the quantity of timber at least ten per cent. annually; but while timber land is being constantly washed away on one side of the river, it is constantly forming on the opposite side, and a little below the point washed away. The new land that is being constantly formed appears first as a strip of sand adjoining the main-land. About the second year it is covered over with a thick growth of red willow; then a few cottonwoods appear on the higher points and ridges. Each successive annual overflow raises the sand-bar and deposits mud and clay on it, which are wed fast by the willows. The decaying leaves assist in

thickening the soil; the cottonwoods spread over it, and in fifteen or twenty years it will become a fine piece of timber land, that is, for this country. It is estimated that at least six hundred acres of good timber land have been washed away within five miles of this post within the last three years.

Of course I do not profess to be accurate in the estimates I make of the timber land washed away and remaining, but give my opinion only. Directly in front of this post, and for two miles above it, a large body of land is forming along the west bank, pushing the river-bed in some places nearly half a mile further east than it was three years ago at the same point. It must be observed, however, that the destruction of timber near the posts far exceeds the growth of it on the new lands.

6th. Whether the planting of trees has been resorted to, and with what success: Trees have been planted at Forts A. Lincoln and Rice, and at this post, with perfect success. While in command at Fort A. Lincoln I caused nearly one thousand trees to be planted. All that were placed in suitable ground have grown finely. Some of them died because they were placed in hard, dry spots, and some from the want of water; but those planted in the damper places that produce high, coarse grass, and that have sufficient moisture in the soil, have grown with great rapidity and have become beautiful shade trees.

The trees planted at Fort Rice look remarkably thrifty. The majority of the trees planted at this post last spring by my directions have generally grown well; but as they were not sufficiently trimmed when transplanted they have not thriven as well as they would otherwise have done. When trees are transplanted, thrifty young trees about two inches in diameter at the ground should be selected. All the branches should be cut off, also the main trunk about 8 or 9 feet above the root. They should be planted in holes about 30 inches in diameter and 2 feet deep; shallow and narrow trenches should be dug so as to conduct the surface rain-water to the tree for a distance of 6 feet or more. The arrangement of these trenches and their direction must depend on the slope of the ground. It is well to have the loose earth around the tree one or two inches lower than the ground level, so as to hold water. For shade trees transplanting is the best method. For forests and plantations slips and roots should be used, to save time and labor. Roots enough to plant can always be found along the banks of the river, creeks, and sand-bars. I have never planted any other trees in this region than cottonwood, but I believe soft maple would flourish here as well as the native trees of the locality. It is probable, too, that sugar maples would grow finely along the streams and in well-watered places.

If stringent laws could be passed by Congress and the legislatures to prevent prairie fires, it would be greatly to the benefit of this region of country in respect to the growth of timber and the preservation of grass for hay and grazing. No trees have been planted by private parties in this region, for the reason that no permanent settlement can be made on the reservation. It would be a very easy and economical matter to plant and grow all the timber necessary for fuel, building purposes, and shelter of stock in this locality, and if the General Government would exercise a little care to prevent fires and to regulate the cutting of the timber, it is my opinion that all the northern half of Dakota Territory would become a well-timbered country in fifteen or twenty years.

FORT RICE.

Latitude, 46° 30′; longitude, 100° 34′. On the right bank of the Missouri River.

Dr. BLAIR D. TAYLOR, assistant surgeon, U. S. A., says:

I have the honor to submit the following report on this reservation and adjacent country, as called for in circular letter of the 8th instant from department headquarters, and in your indorsement of the 11th instant referring the same to me:

1st. The present extent of the forest area: The forest on this reservation, with the exception of a few isolated clumps of small trees in hollows and ravines, is confined exclusively to the Missouri River bottoms and those of the Cannon Ball River. North of the post is a large bottom about four and a half miles in length, and varying from one-half mile to seven and a half miles in width. Nearly eight miles further up the river is another bottom not quite so large. On the south side of the post is a narrow strip of timbered bottom extending to the Cannon Ball River, eight miles below.

The latter river has narrow, timbered low-lands on each side. Opposite the post, on the east bank of the Missouri, is a small bottom one and a half miles long and one-half mile wide. On the same side of the river, seven miles north, is a large bottom of about the same area as the one first mentioned, and well timbered.

On all these bottoms the original growth of timber is very scarce and is confined to a few large trees very much scattered. The majority of the trees are the growth of the last thirty-eight or forty years.

On nearly all of the low-lands mentioned the forest constitutes about one-half of

the area, and I have made a calculation based upon this fact, giving 4,430 acres as the amount of timbered land along the Missouri from eight miles below this post to twelve miles above.

2d. The lines of natural drainage: These are constituted from south to north by the Cannon Ball River, Mule Creek, just below the post and on the east bank of the Missouri, and Lone Lake Creek, opposite this point. All these streams run generally east on the west side of the Missouri, and in the reverse direction on the other side. Besides these, the country is intersected by many wet-weather ravines running perpendicular to the Missouri, with secondary gulches emptying at right angles to them.

3d. The elevation, whether ascertained barometrically or otherwise, and the rainfall, and the manner in which both have been ascertained: The elevation at this point is 2,200 feet above the sea level; it was ascertained barometrically by some engineer officer whose name is not recorded. Appended is an abstract marked A (see Appendix), giving the rainfall and average yearly temperature from May, 1870, to November, 1877. This has been compiled from the meteorological records of the post hospital. It will be seen that nearly all the precipitation takes place from April to November, and, what is not shown on the abstract, more than half of the rainfall occurs in May and June. It will also be noticed that the rainfall is increasing rather than diminishing.

4th. The various characteristics of the timber, and the extent, condition, and growth of such timber, together with any information of interest connected with the general subject of the forestry of the country: There are only four varieties of timber useful for fuel or lumber in the forest area above mentioned, viz., cottonwood, elm, ash, and a very small proportion of oak. Of these, cottonwood constitutes nine-tenths of the forest, and if well-seasoned makes excellent fuel and fair lumber, but in its green state it retains water like a sponge, will not burn, and warps in the most remarkable manner. The cottonwood grows very rapidly, but decays very soon after reaching a diameter of two or two and a half feet. Most of the forest, as before mentioned, consists of comparatively young trees which are repairing to some extent the waste among the older ones. With such a rainfall as we have had for several years past, there is no reason why trees should not grow on the prairie if properly transplanted.

5th. The rate of decrease in the amount of timber and the cause of such decrease, as, for instance, by fire or through the agency of man: Timber in the bottom lands of the Missouri is seldom if ever injured by fire, because at the time when prairie fires generally occur out here the grass in the bottoms is not dry enough to burn to any extent, and even if it does, the heat is seldom great enough to destroy even the undergrowth.

The destruction of timber in this country is chiefly through the agency of man—cutting wood for posts and for steamboats. There are other agencies, however, which may be mentioned, such as the undermining of its banks by the Missouri River, which annually swallows many acres of fine trees, converting them into dangerous snags or soggy drift-wood. The annual spring overflow of the river leaves the bottoms in many places waist deep in water until the middle of summer, thereby hastening the process of decay in such trees as are already affected. The high winds of spring and autumn generally prostrate a large number of trees which have passed the vigor of their growth. To these might be added the destruction caused by beavers on such streams as they inhabit, *e. g.*, the Cannon Ball.

It is almost impossible to state with any mathematical certainty the rate of decrease of timber, but in my opinion at least one-fourth more timber is annually destroyed than is replaced by a new growth, and it is the agency of man which throws the balance on the losing side, the process of nature *pro* and *con* being in equilibrium.

6th. Whether the planting of trees has been resorted to; and if so, whether by shoots or transplanting, and with what success: Except inside of garrisoned posts I know of no general attempt to plant trees. Transplanting has been successful at this post, many of the cottonwoods on the parade being taller than the houses, and from four to ten inches in diameter after five or six years' growth. The great difficulty in setting out trees on the open prairies is the certainty of being blown down by high winds before they have acquired sufficient root to support themselves. Quite a large tree was destroyed in this way inside of the garrison in 1876.

The only way to make transplanting successful out of the bottoms would be to begin along the ravines and bottoms and gradually extend toward the prairie as the trees become numerous enough to offer a barrier to the wind. I know nothing of setting out shoots, and do not believe it would succeed.

FORT A. LINCOLN.

Latitude, 46° 46′ 17″; longitude, 100° 50′ 37″. On the right bank of Missouri River. The average monthly rainfall from November 1, 1876,

to October 31, 1877, was 2.17 inches, ascertained by gauge. Elevation 2,211 feet, determined barometrically.

Major J. G. TILFORD, Seventh Cavalry, says:

The forest area of this reservation is about thirty-two hundred acres approximately, as follows: Sibly Island, twelve hundred; first point below the post, three hundred; second point below the post, seventeen hundred.

The timber on the first is very sparse, the best having been cut to supply the post with fuel and for building purposes.

A growth of young trees is springing up on the river front, but will not be available for fuel within ten years. The timber on second point is of larger growth and almost in its primeval state, very little having been cut by the whites. There is also quite a forest of box-elder only fit for fuel. The timber is almost entirely of cottonwood; there is some ash and a very little oak, known as scrub oak. The only decrease observable is by the agency of man.

Tree planting was first resorted to (at the cavalry barracks) in the spring of 1874. The first trees were very large, and although great care was taken to save them, they all or nearly all died during the heat of summer. These trees have been replaced by smaller trees which have now become rooted in the soil and promise to do well.

Although I have not seen it tried at this post, but at places along the Missouri River, slips cut from cottonwood have been started in the spring, and they grow so rapidly that orchards of several hundred trees were seven and eight feet high in two years after planting.

FORT STEVENSON.

Latitude, 47° 34′; longitude, 101° 26′. On the left bank of the Missouri River. The rainfall for the year 1877 up to November 16 was 10.13 inches, measured by a gauge.

Major O. H. MOORE, Sixth Infantry, says:

The original forest area of this reservation was comprised in the bottom-lands adjacent to the Missouri River, but practically no forest now exists, all the larger trees (principally cottonwood) for ten miles either way having been cut for various purposes. In the early days the wood contractors drew heavily upon the timber near the post, and later all that remained has been used from time to time in the construction of various log buildings, so that the only trees now upon the reservation are small cottonwoods, hardly more than saplings. Prairie fires usually occur every fall, and their effect may be to keep down any growth of forest that might spring up in the coulisse near the bluffs, but to these fires cannot be attributed in any degree the destruction of such timber as formerly existed in the bottoms. To obtain logs of over six inches in diameter it is now necessary to raft them down from a point some thirty miles up stream, on the opposite bank of the river. The most extensive forest in this whole vicinity is the finely timbered country of the Mouse River, some sixty miles away.

The transplanting of trees for foliage has been undertaken to a limited extent, but the result of some five years' experience has not been encouraging, though in a few instances good, substantial trees have resulted. Cottonwood has been the variety heretofore planted, but the past year a few ash trees were set out and appear to be thriving at present.

FORT BUFORD.

Latitude, 48°; longitude, 103° 57′ 30″. On the left bank of the Missouri River, near the mouth of the Yellowstone. The elevation is 1,933 feet, determined barometrically.

Colonel DANIEL HUSTON, Sixth Infantry, says:

In reply to circular letter dated Headquarters Department of Dakota, Saint Paul, Minn., November 8, 1877, I have the honor to state:

1st. The growth of timber is confined to the flats pertaining to the Missouri and Yellowstone Rivers, as a rule being on alternate points on opposite sides of the river, said points being from one mile to three miles wide at the base and running out to a point.

The timber down the Missouri River on reservation and adjacent country is dense, and not cut out to the extent of that above the post. The timber up the Yellowstone is of a larger and finer quality than on the Missouri River. It is principally cottonwood, with a very little ash and elm, with scrub-cedar in the bluffs on the river.

2d. The lines of natural drainage are very fine on the north and east of the post, being drained by the Muddy Creek that rises to the northwest from the fort, its general direction to its mouth being southeast, entering the Missouri River about twenty-five miles east of the post. From ten miles back from the garrison the drainage is into the creek and its tributaries. To the west is the Little Muddy Creek that rises to the north and runs south to its mouth, entering the Missouri River about twelve miles west of the post. These creeks have numerous tributaries. There are also on the reservation numerous small creeks. South of the Missouri River the drainage is confined to the Yellowstone River and its tributaries.

The surface draining of the area occupied by the post is excellent—a depression on either side of it sloping gradually toward the river, and the gradual descent of the ground intervening between the post and the river at the south afford a natural water-shed that entirely prevents the accumulation of stagnant water, except for brief intervals after heavy storms. The flood plains or bottom-land of the Missouri River is from forty rods to several miles in width, and at intervals of several years is covered with water from unusual rainfalls or melting of large masses of snow. Back of this is a grassy plain of from one to five miles in width, extending to the foot of the hills. Through this plain at varying distances run innumerable ravines or coulisse from the hills to the basin lands of the river. Admirable surface draining is thus afforded, and, except during very wet seasons, few of them contain water. The water, when found, is apt to be strongly impregnated with sulphate of soda and lime, which impart to it a harsh, alkaline taste. The deep drainage appears from the structure of the soil, observed in digging wells, to be affected by percolation of the water through slanting strata of gravel and sand inclosed between layers of tenacious clay.

3d. The elevation of the post above the sea-level is about 1,900 feet, obtained by barometrical calculation. The amount of the rainfall for the past ten years is shown by the accompanying table (see Appendix), condensed from the meteorological register kept at the post hospital. The mode by which data were obtained was by measurement with a graduated standard of the amount of rain caught by a funnel-shaped vessel.

The violent wind usually accompanying rainfall in this latitude introduces, I think, an element of error in estimating the amount of precipitation in the manner above given, and it would seem that the rainfall must be greater than represented by the table.

4th. The characteristic growth of the forests in this vicinity is the cottonwood (*Populus monilifera*). It constitutes the bulk of the trees found fringing the water-courses, and is the only wood available in any quantity for fuel or building purposes.

Among other representatives of the forest are the ash-leaved maple (*Negundo aceroides*), the red osier, dogwood (*Cornus stolonifera*), scattered rather sparingly along the river banks. Red cedar of a small, stunted character is occasionally found on the hills. A species of willow finds a place in low moist grounds. The wild plant *Prunus Americana* is found in ravines and skirting the prairie side of the wooded river-banks. This tree bears the best indigenous fruit this country affords. The choke-cherry (*Prunus Virginiana*), is found in much the same localities. Both varieties are limited in number. Among the shrubs of interest for their economic value are the buffalo or bull berry (*Shepherdia argentea*), the Missouri currant (*Ribes aureum*), and the smooth white gooseberry (*Ribes hirtellum*). The timber, with the exception of cottonwood, which is of insufficient growth or magnitude to be of any considerable value, is almost wholly confined to the flood plains of the Missouri and to like situations along its tributaries. As we recede to the interior this feature gives way to rolling plains, covered with grass, cactus, and sage brush, or to the rugged, arid country known as the "Bad Lands." There have been three causes undoubtedly operating in this section to repress the extension of trees beyond their present habitat, viz., prairie fires and drought, and the high and almost unintermitting winds.

My observations lead me to believe that the cottonwood cannot be transplanted and cultivated in situations remote from the localities to which it is now confined with any success. A row of young cottonwood trees set out in front of the post hospital some seven years ago have not thriven well, although they have had special care. Only two of them have in that time grown to the height of about ten feet; the others are still mere bushes, not more than three feet high. I have not heard of their successful culture anywhere in this vicinity. Among the indigenous shrubs and trees above enumerated are some that might with advantage be introduced into the post.

5th. The decrease in timber, in my opinion, is very rapid, owing almost entirely to wood being cut for steamboats and filling the contracts for the post.

6th. With the exception of the trees before mentioned, as planted in front of the post hospital, no attempt has been made towards growing the same. The hospital trees were transplanted with the success noted above.

MONTANA TERRITORY.

FORT KEOGH.

Situated on the Yellowstone, near the mouth of Tongue River, and about one hundred and ninety-four miles from Fort Buford. Elevation 2,832 feet, determined barometrically. This post was established so lately that no record of the rainfall was kept prior to August 1, 1877. Since that time the fall has been as follows:

	Inches.
August	0.00
September	0.70
October	0.61
November	0.46
Total	1.77

The annual fall is estimated to be from 12 to 20 inches.

Major GEORGE GIBSON, Fifth Infantry, says:

The timber found in this vicinity consists of cottonwood (principally), together with some ash, scrub-cedar, and pine. A tolerably fair body of ash is reported on Pumpkin Creek, which empties into Tongue River about twelve miles south of this post. The cedar and pine are confined to foot-hills, as well as ravines running up into the bluffs. So far they have proved of little or no value. The cottonwood may be said to grow in groves of various extent.

Very considerable inroads have been made upon the timber within a space of from ten to twelve miles, both for the purposes of fuel and for constructing the post. Possibly next year or the succeeding one it will be necessary to bring a sufficiency of fuel from a considerable distance by rafting it down the Yellowstone and the Tongue.

It will be seen from the above that a great deal of timber has been cut, and will for some time continue to be cut, along the Missouri and Yellowstone Rivers and vicinity. The military posts, the Indian agencies, and steamboats consume immense quantities of wood.

FORT CUSTER.

Situated at the junction of the Big Horn and Little Big Horn Rivers, about fifty miles from the Yellowstone. Elevation 3,450 feet, determined barometrically.

Lieutenant Colonel G. P. BUELL, Eleventh Infantry, reports that the present extent of the forest area consists of a belt of timber averaging half a mile in width from the post up the Little Big Horn and Big Horn Rivers for a distance of some thirty miles. The timber consists of cottonwood, "of fine growth and thickly planted." "About eighteen miles from the post a ridge runs east and west, fairly covered with a good growth of fine timber. With this exception and near the rivers the country is bare."

FORT BENTON.

Latitude, 47° 49′ 38″; longitude, 110° 39′ 48″. In the town of Fort Benton, at the head of Missouri navigation. Elevation 2,663 feet, ascertained barometrically. Rainfall, from November 24, 1876, to November 25, 1877, was 16.74 inches.

Major GUIDO ILGIS, Seventh Infantry, says:

The Teton River, the northern boundary of the reservation, has a few small cottonwood trees in its valley. The Teton, some miles above the reservation, is well wooded with cottonwood. The mountains are well wooded with pine. The timber along the river bottoms is generally cottonwood of several varieties and willow, generally small trees, though in some instances they gain a diameter of two or more feet. The cottonwood is unfit for lumber, but makes very fair fire-wood. The mountains are generally covered with pine trees of moderate size, which are largely used for timber, but they are too knotty for lumber of the finest quality.

Along the Missouri River and its tributaries the rate of decrease is very large,

threatening total destruction to the forest at no very distant future. This is owing to the large amount of wood cut for the use of steamboats—large as compared with the supply. In those regions farther from the river the rate of decrease is less.

A few trees have been planted in the town for shade-trees. They were transplanted. The oldest transplanted trees have now been out about two years and are thriving well. They require irrigation.

CAMP BAKER.

Latitude, 46° 40′ 44″; longitude, 111° 11′. In Smith's River Valley. Elevation, 4,538 feet, determined barometrically. The rainfall for 1876, as given by the gauge, was 17.49 inches.

Lieutenant Colonel C. C. GILBERT, Seventh Infantry, says:

The trees of the adjacent country are pines, and are almost exclusively found on the hills and mountain ranges, and the body of timber on the latter is nearly always heavy, and on the lower hills it is light and scattering. The timber is entirely of pine and covers the mountains in dense masses and large growth, and will make fair lumber at the saw-mill.

The rate of decrease of timber has been inconsiderable, if at all. The decrease for fuel, fencing, and building material is compensated for by the natural increase.

The planting of trees at this post has been tried, but without success, owing to the high winds.

FORT SHAW.

Latitude, 47° 30′ 33″; longitude, 111° 48′ 19″. On the right bank of Sun River. Elevation not known. The annual rainfall varies considerably, the maximum for eight years being (1876) 14.62 inches and the minimum (1874) 4.24 inches; the average, 8.52, ascertained by means of gauge.

Colonel JOHN GIBBON, Seventh Infantry, says:

The only timber on this reservation is thinly scattered cottonwood along Sun River. On the mountains, situated from twenty-five to fifty miles from the post, immense masses of pine timber exist. Most of the timber on the mountains is pine and fir, of an excellent quality generally and sometimes very large. There are immense quantities of it. The growth of cottonwood of three kinds, along the river bottoms, is not heavy, and most of it in this region has already been cut for fire-wood.

Immense quantities of the timber in the mountains is almost annually destroyed by fire. The rate of decrease cannot be estimated with any accuracy. Except in the vicinity of the more thickly settled portions of the Territory the decrease is caused by fire. Near the settlements it is removed in large quantities for lumber and fire-wood.

Large numbers of trees have been planted in the garrison, water being supplied by irrigation. All the trees have been transplanted in the winter time and a vast majority have succeeded. The varieties are three species of cottonwood, the quaking asp, and fir. The latter do not succeed well. The quaking asp has had only one year's trial and is succeeding tolerably well. The cottonwood succeeds best, and will grow in almost any soil if plentifully supplied with water.

FORT ELLIS.

Latitude, 45° 40′ 15″; longitude, 110° 50′ 04″. In the eastern end of the Gallatin Valley, on the left bank of the East Gallatin River. Elevation, 4,747 feet, determined barometrically. The rainfall, as ascertained by the gauge, is shown by the following table for the years 1876–'77:

Month.	Fall in inches.	Month.	Fall in inches.
1876.		1877.	
July	0.18	January	0.48
August	2.01	February	0.43
September	0.75	March	1.36
October	0.69	April	0.86
November	0.83	May	4.28
December	1.07	June	2.30

or a total fall of 15.24 inches.

Major JAMES S. BRISBIN, Second Cavalry, says:

The present extent of forest area of the Fort Ellis Reservation is about fifteen thousand acres. The mountains in the southern part of the reservation are clothed with forests of white pine, red fir, and cedar. The extent of each kind of timber cannot be exactly told, but their condition is very good, and they grow very thick, but not heavy. There is also some aspen and spruce in small quantity, and cottonwood grows along the banks of the East Gallatin and in the bottoms of the creeks, but not to such an extent as to be of any material use.

Assistant Surgeon L. M. MAUS, U. S. A., in a report referred to me, says:

Cottonwood is the principal timber between the Cheyenne River and Standing Rock; although there is quite a good proportion of burr-oak, elm, ash, and willow. Cottonwood is found in large quantities in the bottoms of the Cheyenne, Moreau, and Grand Rivers. About fifteen miles southwest of the post (Standing Rock), between Oak Creek and Swift Water Creek, is a section of the country which is broken by many ravines, all of which are well timbered with the burr-oak. The oak wood is found principally in the ravines which intersect the different rivers and creeks. The bluff surrounding the Cheyenne River is tolerably well covered in some places with a cedar growth. The bottoms of the rivers and creeks also contain a growth of red and white willow, wild plum, and bullberry bushes.

ARIZONA TERRITORY.

Captain J. H. COSTER, Eighth Cavalry, A. D. C., acting engineer officer for the Military Division of the Pacific, furnishes the following report:

GRANT CAMP.

Situated 4,833 feet above sea-level, on the northwestern base of Graham or Sierra Bonita Mountains, on a sort of mesa sloping towards an extensive plain about fifteen miles wide and over one hundred miles long. On this plain there are no trees of any kind south of Camp Grant, but scattered mesquite (bush) to the northward and to the valley of the Gila River. Abundant mesquite is to be found on the mesa between elevations 4,000 and 6,000 feet. This timber is intermixed with two varieties of oak and one of juniper, up to an elevation of 7,000 feet.

On the mountain's sides, foot-hills, and between 7,000 and 10,500 feet (highest peak of Graham Range), white and yellow pines and fir grow in sufficient quantities to be called forests, scattered through which is found one species of juniper. This timber is of great commercial value if the rugged character of the mountains will permit of extended use.

The margins of the numerous small streams are lined with cottonwood trees till the mesa is reached, where the streams sink and the wood disappears.

Rainfall, 1873, 18.28; 1874, 16.92; 1875, 20.72; 1876, 20.12; 1877, 7.27 inches.

CAMP APACHE.

Latitude, 33° 46′ 47″; longitude, 109° 54′ 40″. The camp is situated nearly in the centre of the San Carlos Indian Reservation, in the White Mountains. The streams near it are the east and north forks of the White River. The cañons make the lands bordering on them useless for any extended system of agriculture, and the small spots that are capable of cultivation are only suitable for Indians to raise their corn on. The timber in the vicinity of the post is cedar and juniper. About nine miles from the post there are quite extensive pineries, extending probably ten miles to the north. Has no instruments to determine elevation of mountains in vicinity, but refers to the report and maps of Lieutenant Wheeler, Corps of Engineers, U. S. A., for this information.

CAMP BOWIE.

Latitude, 32° 08′ 14″; longitude, 109° 22′ 45″. The forestry of this portion of the Territory is unimportant. The timber is not plentiful, and is found only on the northwestern slope of the mountain ranges, principally the Chiricahuas, at an elevation of about 3,500 to 4,800 feet. The principal growths of timber are pine and oak. Spruce, cedar, sycamore, and walnut of dwarf species are also found.

In some of the larger cañons pine attains a great height, and, where well protected from the strong winds, grows in abundance.

The extent of the forest area is about 580 square miles.

The lines of drainage are northwest and west, mostly subterraneous, and empty into the Gila River.

The principal rainfalls occur in July and August; the amount of rainfall during those months in 1876 was 8.55 inches, and in 1877 8.00 inches. The total amount of rainfall during the past two years was 26.55 inches. Very light and occasional falls of snow occur during the winter months.

FORT YUMA.

Latitude 32° 43′ 32″; longitude, 114° 36′ 09″. The post commander reports that the post is on three sides encompassed by the river bottom, which at this point averages about five miles in width. These bottom lands give the forest area of this vicinity. They are densely covered with mesquite and an undergrowth of arrow-weed. Cottonwood, willows, and mesquite grow on the banks of the river and lagunas.

The Colorado River and its tributary, the Gila River, form the line of drainage of the surrounding country.

The average annual rainfall at Fort Yuma for the last five years has been 4 inches, as ascertained by actual measurement. This, with the annual overflow of the Colorado River, gives sufficient moisture for a dense growth of timber on the bottom lands.

None of the trees mentioned attain a height of over 30 feet. The cottonwood and willows are stripped of their bark and used for building fences and as a foundation for mud roofs.

Of the mesquite tree (a tree of the *Mimosa* family, with thorns and small pinnated leaves), two varieties are found in the vicinity of Fort Yuma, the long-pod mesquite (*Algarobia glandulosa*) and the screw-pod mesquite; the former bearing a pod from 4 to 6 inches in length, and the latter, as the name implies, bearing a pod in the shape of a screw, from two to three inches long. These pods contain from six to twelve beans, inclosed in a pulpy substance. They have a flavor not unlike the tamarind, contain a considerable amount of saccharine matter, and are wholesome and nutritious. Both varieties are used by the Yuma Indians for food. They gather the beans in large quantities when ripe, and reduce them to flour by grinding between two stones. Large quantities are also sold to the whites, and used as food for horses and cattle. The mesquite tree also furnishes a kind of gum, which has the same properties as gum arabic, and can be used for all purposes to which the latter is applied. It flows from the bark of the tree during the summer months, and hardens on exposure to the air.

On the mesas, which border on the river-bottoms, the vegetation is very scant, and consists of a few stunted mesquite trees and several varieties of cactus.

CAMP M'DOWELL.

Latitude, 33° 40′; longitude, 111° 40′. Mesquite wood and palo verde abound in plentiful quantities on the plains surrounding this post. Cottonwood is plentiful in the Salt River bottom, and from these sources the post is supplied. As the mesquite and palo verde are of short growth, and the cottonwood found only in the bottoms, it cannot be said that there is anything like a forest in this vicinity. The mesquite and palo verde are a very hard wood, the former of a dark color, the latter light. Cottonwood is soft and light.

The elevation of the post, taken barometrically, is 1,800 feet above sea-level. The rainfall at the post during the year 1876 was 8.20 inches.

FORT WHIPPLE.

Latitude, 34° 33′; longitude, 112° 30′. The commanding officer reports that the forestry in the vicinity of this post consists principally of pine (pitch and spruce), juniper, cedar, scrub oak, and some manzanita. A belt of timber, principally pine, called the Bradshaw timber-belt, extends about forty miles south and twelve miles west, and is about twenty miles in width. To the east the timber (pine and scrub-oak) extends about four miles. To the north there is but little timber. The pine timber is rapidly disappearing, supplying the saw-mills in this vicinity, and for fuel. The arable land is not very extensive; cultivation is confined to valleys that retain moisture, and the rainfall is principally relied upon for success. In very dry seasons the crop is an entire failure. An instance of this kind occurred last year, when scarcely grain enough was raised by the farmers to supply their own wants. The largest arable tract (about one thousand acres) is on Willow Creek, and three or four thousand acres will cover the total arable land. All the farmers depend on the natural water-supply,

there being, except for garden-spots, no irrigation by acequias. There are but few streams of water, and none that can be relied upon. Granite Creek, in the neighborhood of the post, is most of the time without running water, and the supply for the post is obtained from wells sunk in the bed of the creek.

The principal products in this vicinity are corn and potatoes. Good grazing is to be found in favorable seasons.

CAMP LOWELL.

Latitude, 32° 12′ 55″; longitude, 110° 52′ 55″. This post is located on the Rillito, about eight miles south of the highest peak of the Santa Catarina Mountains, about seven miles east of Tucson, in Pima County, Arizona. Latitude, 32° 12′ north; longitude, 33° 49′ west; altitude about 2,530 feet above the sea by barometer.

The Rillito River takes its rise by three distinct streams in the Santa Catarina Mountains. This river, or rivulet, and the branches which unite to form it, like the majority of the streams in Arizona, sink in many places, and, running under ground for some distance, rise again. It is insignificant in size at this point, but its bed enlarges as it descends to join the Santa Cruz, nine miles north of Tucson. Its waters cease to run above ground about a mile below the camp, and do not rise again until they join the Santa Cruz. The alluvial deposit at this camp is about two feet deep, resting on a layer of calcareous sedimentary deposit from two to four feet in thickness. Underneath this is a layer of gravelly earth about fifteen feet thick, and below that a stratum of clay from one to two feet thick, when a bed of gravel of unknown thickness is reached, in which, at a depth of from five to ten feet, living water is obtained.

The rainfall is chiefly in July and August, aggregating for an entire year from 7 to 15 inches.

Cottonwood grows at intervals on the banks of the Rillito and Santa Cruz, and in some places attains considerable proportions.

There are forests of excellent white pine, interspersed with a few pitch pines, in the Santa Catarina and Santa Rita Mountains, but they are difficult of access. The white ash and white oak attain a considerable size in the foot-hills in the eastern part of the reservation, and on the borders of the stream the alder and sycamore grow quite large.

With few exceptions the mesquite trees are very small and stunted in the mesa, but in the valley of the Rillito, and in that part of the Santa Cruz Valley north of the San Xavier mission, south of Tucson, they grow quite large—would make excellent lumber for some purposes, and are unsurpassed for fuel.

The drainage of the post is natural, the ground being somewhat rolling. That portion of the water which is not absorbed by the soil passes off rapidly to the stream.

CAMP THOMAS.

There are no forests in the immediate vicinity of the post, timber being very scarce, consisting of only two principal varieties—cottonwood and mesquite. A fine belt of the former grows along the banks of the Gila River, near which this post is situated. The growth is not dense, but the tree attains a considerable height, with a trunk of proportionate thickness. Cottonwood belongs to the genus *Populus*, a soft wood, and is principally used in the construction of the houses of the country, being almost worthless as fire-wood.

Mesquite belongs to the class of hard-wood trees, and grows in fair quantity in the vicinity of the post, but sparsely on the adjoining plains. It attains a height of about thirty feet with proportionate thickness; its wood makes excellent timber for wagon spokes, &c.

The elevation of this portion of the valley is approximately 2,500 feet above sea-level. The approximate annual rainfall is 14 inches. The values for the rainfall and elevation are approximations because there are no instruments here by which to obtain the exact ones.

CAMP VERDE.

Latitude, 34° 37′; longitude, 111° 55′. Neither immediately nor within thirty miles in any direction from this post are there either forests or even trees of a respectable size. A few cottonwood grows on the banks of the Verde River and its tributaries; a few oak, ash, and sycamore trees along Copper Cañon Creek, and a few scrub cedars and piñons are found on the foot-hills. There is not enough wood of any and all kinds found on the reservation to supply the post with fuel. On the Mogollon Mountains, from thirty to fifty miles distant from the post, and at an elevation of 6,000 feet and upwards, there are primeval forests of pine. In some places the growth is dense and the trees of respectable dimensions. These forests extend from the northwest to

a little south of east of this post, and vary in width from fifteen to forty miles. To the west and south of the post the hills are destitute of trees of any magnitude. On the western slope of these hills occasional pineries are found in some sheltered localities. With the exception of the pine no timber is found available for any purpose except fuel and fencing. The hard-wood trees are almost invariably hollow.

The post is situated in a large valley of the Verde River at an elevation, barometrically ascertained, of 3,500 feet.

The average yearly rainfall is 8.97 inches.

The country for sixty miles to the north and northwest, for ten miles direct west, and for fifty miles east, is drained by the Verde River, whose principal tributaries before reaching this post are Hell Cañon, Oak Creek, and Beaver Creek. Four miles below the post and to the southeast Clear Creek runs into the Verde River. All these streams drain the southwestern slope of the Mogollon Mountains, become very low in the dry season, and are liable to sudden and heavy floods in rainy seasons, and when the snow melts in the spring. The general direction of the Verde River through the valley in which the post is situate, that is for about thirty-five or forty miles, is from northwest to southeast.

CALIFORNIA.

CAMP GASTON.

Is situated in Hoopa Valley, Humboldt County, California. Latitude, 41° 5′ north; longitude, 123° 15′ west. Elevation, 397 feet. The country surrounding the post for eighty to one hundred miles (and how much farther is not known) is very rough and mountainous, and a large portion of it very heavily timbered, consisting of black and live oak, pines, yellow spruce, and fir, cedar, redwood, maple, madrona, &c. The lines of drainage are Mad River, Eel River, Redwood Creek, Trinity, Klamath, and Salmon Rivers. The general direction is northwest, and empty into the Pacific Ocean.

Rainfall from April 1, 1877, to April 1, 1878, 69.41 inches.

CAMP BIDWELL.

Latitude, 41° 51′ 34″; longitude, 120° 5′ 59″. Elevation above sea-level, 4,680 feet.

The commanding officer reports that the extent of timber is limited, being confined to the mountains (Warner) on the west side of Surprise Valley, between it and Goose Lake, a distance of about fifteen miles, half of which distance probably has timber, and extending in direction of the mountains fifteen or twenty miles.

The drainage on this side is by small creeks which empty into a lake in Surprise Valley without an outlet. The timber is principally white pine and grows from one to three and a half feet in diameter at bottom, making quite excellent lumber. These trees generally grow at some distance apart and are straight, clear, and tall. Added to the white pine, cedar (red and white), mountain mahogany, and cottonwood (along the creeks) are found in limited quantities. The timber seems to have been cut away considerably and does not appear to be renewing to any extent. The average elevation at which the pine grows is about 5,200 feet, the others somewhat lower. Average rainfall about 17 inches.

NEVADA.

M'DERMITT CAMP.

Latitude, 41° 58′ 3″ north; longitude, 117° 45′ west. The commanding officer reports post at an altitude of 4,700 feet. Average rainfall since 1871 (per observations), 7.14 inches. No forests in vicinity, even fuel being obtained thirty miles away. Few small cottonwoods on the banks of Guinn's River.

OREGON.

HARNEY CAMP.

Latitude, 43° 30′ north; longitude, 118° 30′ west. The only timber in vicinity of post is that covering the Blue Mountains, and consists of pine, fir, and tamarack, which are found in great abundance in sound and healthy condition making excellent lumber. A belt of timber extends north to the Snake River, is two hundred miles in length and seventy-five in width. Average elevation (by barometer) 6,500 feet. Direction of drainage lines north to branches of the Columbia and Snake Rivers. Average rainfall, 8.69 inches.

FORT STEVENS.

Latitude, 45° 40′; longitude, 122° 40′. This reservation consists of about 640 acres, bounded on the north and east by the Columbia River and on the west by the Pacific Ocean; to the south are extensive sand plains now covered by a coarse grass much liked by cattle. The plains have evidently at one time been the bed of a bay or arm of the ocean. The whole reservation, with the exception of this portion where the works and quarters for officers and men stand, is covered with a dense growth of hemlock and pine which is almost impenetrable, caused by the thick growth of underbrush which consists of alder, salmonberry, blackberry, and ferns, which grow to a gigantic size. The elevation of the reservation above high water has a mean of about eleven feet. The soil is a black, sandy loam, very porous; therefore, notwithstanding the heavy rainfall, the surface is comparatively dry. The annual fall of rain is very great, being for 1877, 94.30 inches, and for 1878 to May 1, 24.27 inches.

The country surrounding this point has about the same characteristics, the Oregon side of the Columbia River being for some distance back low and sandy. In the sheltered places (from the southeast and northwest winds) producing almost anything, but being specially adapted to vegetables that require a great deal of water.

On the opposite side of the river, in Washington Territory, the land rises abruptly from the beach to a height of several hundred feet, and is as densely covered with the same kind of timber and under brush as the reservation.

FORT KLAMATH.

Latitude, 42° 43′ 41″; longitude, 121° 55′. Report states that the forest area is coincident with the mountain area, and embraces at least two-thirds of the acreage.

The main lines of drainage, other than the slopes of the mountain ranges, are south and west by the Klamath River; south by the McCloud, Sacramento, and Pitt Rivers; west by the Rogue River, and north by the Deschartes River.

The general elevation of the interior valleys east of the Cascade Range is about 2,000 feet, west of the range about 4,000 feet, of the table lands 5,000 feet, and of the monntains 8,000 feet. These elevations have been obtained barometrically.

The rainfall of the Klamath Lake country is — inches, obtained by rain-gauge and estimate.

The Cascade, Siskiyou, and Blue Mountain ranges are densely covered with forest trees, consisting mainly of, 1st, all the varieties of fir; 2d, several varieties of pine, among which are the sugar pine, white pine, screw pine, and spruce pine; 3d, the white cedar; 4th, yew; 5th, live oak; 6th, burr oak; 7th, jack oak; 8th, laurel; 9th, swamp maple, and 10th, aspen. On the eastern, northern, and generally higher and colder slopes of the ranges, with the exception of a few aspens, only evergreens are found. The deciduous trees are found on the lower foot-hills and warmer slopes of the mountains. The growth of forest in the mountains is rank and increasing; in the valleys and table-lands, sparse and decreasing. The main growth of forest is confined to the mountain areas or the immediate vicinity, and is very extensive.

IDAHO TERRITORY.

FORT BOISÉ.

The commanding officer reports that there is no forestry bordering on the plains in this vicinity. The nearest body of timber is about ten miles northeast, and extends some thirty or forty miles into the mountains, and consists of white pine, fir, and cottonwood in abundance. The nearest line of drainage is the Boisé River, about one mile west. The Boisé empties into the Snake River about sixty miles southwest of this post at a place called Old Fort Boisé.

The elevation of this post is 2,892 feet above the level of the sea. The rain-fall at the post, taken from the official "rain-gauge" at post for the last five years, averages 14.33 inches per annum.

FORT LAPWAI.

Latitude, 46° 32′; longitude, 116° 40′. The post surgeon reports that the forestry on the military reservation of this post consists of a few cottonwood trees bordering on the creek, running through the small valley in which the post is built.

Along the course of the small streams emptying into the Lapwai Creek and the Clearwater River a few scattered cottonwood trees are found.

At a distance, varying from eight to ten miles to the south and about the same distance to the east, on a spur of the Blue Mountain Range, called the Salmon River

Mountain and Craig's Mountain, an extensive body of excellent timber is found, reaching from the Snake River, near the mouth of Salmon River, to and across the North Fork of the Clearwater, some sixty miles. This body of timber is supposed to extend even into Montana Territory. It is estimated that this belt is from five to ten miles in width, and consists of white and yellow pine, red and yellow fir, and white cedar. This timber is of large growth, and valuable for lumbering purposes. Spruce and tamarack are found on the Lolo Creek, a tributary to the Clearwater. Yew trees one foot in diameter are found on the mountains, also mountain mahogany of small size. Silver birch is found on the upper part of the Clearwater.

From these timbered ranges the whole supply of wood for lumbering purposes, and even for fuel, must be obtained, as the greater portion of this section of the country consists of grassy plains and rolling hills, devoid of shade. White-pine logs, five feet in diameter and one hundred feet in length, without a knot, have been rafted down the Clearwater, furnishing the finest quality of lumber for finishing purposes.

At Kamiah, a settlement of the Nez Percé Indians, where are numerous farms of these Indians, they have planted several fruit trees. The cultivation of forest trees could here be successfully carried on and with but little trouble.

The altitude of the post is about 1,000 feet, as indicated by an aneroid barometer, made by Beck, of London.

The average rainfall for a period extending over ten years, from 1868 to 1877, inclusive, is 14.88 inches; mean average temperature for ten years from 1868 to 1877, inclusive, 52°19′.

WASHINGTON TERRITORY.

FORT COLVILLE.

Latitude, 48° 41′; longitude, 117° 55′. The commanding officer states that his facilities for determining the information required are so limited that it is impossible for him to furnish it further than to say that the principal trees in the country belt around his post are cedar, fir, pine, and tamarack. Names the Columbia and Spokane Rivers as the main lines of drainage. Elevation above sea-level, 2,800 feet.

FORT CANBY.

Latitude, 46° 16′ 32″; longitude, 124° 3′ 13″. The entire region around the post is covered with primitive forests. On the north bank of the Columbia River from Cape Disappointment to The Dalles the country is densely wooded, the timber belt running back a considerable distance. In immediate vicinity of post from Baker's Bay to Shoalwater Bay, about six miles, the timber is almost unbroken; country hilly with no distinct line of drainage; elevation from two to three hundred feet. Rainfall during winter 1875–'76, 31.67 inches; summer 1876, 5.49 inches; 1875, 79.65 inches; 1876, 69.52 inches. The timber is composed of spruce, fir, pine, hemlock, beech, and vine maple, and alder, willow and crab-apple in low portions and considerable quantities.

FORT WALLA WALLA.

The post commander states that there is no growth deserving the name of forest in this part of the country. There are some pines, spruces, and cedars, from which fair lumber is obtained, on the mountains within fifty miles; and cottonwood, willow, black birch, and hawthorn, and probably many other trees that are of little or no value, grow along the streams.

Post surgeon (George M. Sternberg, Surgeon U. S. A.) says: "I am not yet able to give information worth recording upon the subject of forests in this vicinity. There is no timber worth mentioning, except upon the summits of the mountains, and as I have not visited these localities I cannot, therefore, form an opinion as to the extent or character of the forests."

PORT TOWNSEND.

Mr. JAMES G. SWAN furnishes the following interesting report of the forestry and rainfall of Washington Territory:

Your communication of the 12th instant, asking for information in relation to the forestry of this section of the country, has been received, and in reply I will give such facts as have come within my personal observation, together with such as are found in the official reports of the engineers of the Northern Pacific Railroad and the surveyors of the land office. A former surveyor-general for Washington Territory says of the region west of the Cascade Mountains that it covers an area of about twenty thou-

sand squares miles (exclusive of interior waters), three-fourths of which are timbered lands. The timber consists of fir, cedar, pine, spruce, hemlock, oak, maple, cottonwood, ash, dogwood, alder, and some of the smaller varieties, such as vine maple, crab-apple, madrone, and wild cherry. The amount of fir exceeds all the other varieties combined, and the cedar stands second in quantity. As the fir exceeds all other varieties in quantity, so it does in quality and utility, being valuable for ship-building, fencing, spars, and indeed almost every purpose for which wood is used. It is stronger than white oak.

The size of the fir trees and the number growing upon given acres in good timber districts is almost incredible to residents upon the Atlantic slope of the continent. Trees often measure 320 feet in length, more than two-thirds of which are free from limbs. Fifty, sixty, and sometimes as high as eighty good timber trees grow upon an acre of ground; from sixty to one hundred and twenty thousand feet is the common yield. The loggers work no timber producing less than 30,000 feet per acre. Over hundreds and hundreds of square miles of area does this unequaled timber exist, astonishing for its size, perfection, and durability. In the immediate vicinity of the tide-waters of Puget Sound the timber suitable for milling purposes has been, in a measure, cut; sufficient, however, remains standing to give the forest the same dense appearance it exhibited in early days; but in the interior, only a few miles from tide-water, the primeval forest still exists in all its grandeur.

On the immediate coast of the Pacific Ocean the forest growth is composed principally of hemlock and spruce. This prevails as far up the Strait of Fuca as Clallam Bay, where the fir begins to make its appearance and farther up takes precedence, spruce and hemlock being quite scarce except on some of the river-bottoms.

The whole of the region between the Columbia River and the sound is covered with dense forest interspersed with prairies of considerable extent, and lakes. The forest comes directly upon the shores of the lakes and bounds the prairies with a full, dark wall of foliage. This is the general rule, but in some places the forest bordering the open spaces is composed of deciduous trees, such as alder, maple, ash, poplar, and crab-apple, with a dense thicket of salal (*Gaultheria shallon*,) salmon berry, bear berry, and other shrubbery.

Through the region west of Hood's Canal is the chain of mountains known as the Olympic Range, extending from Hood's Canal to Elwha as snow-covered peaks, and from Elwha to Cape Flattery as mountain and hill of lesser altitude. The elevation of the mountains of the Olympic Range, as observed by the surveys of the American and English officers engaged in surveying the coast, shows that the three highest peaks lie south of the distance between Port Angeles and Crescent Bay on Fuca Strait, and measure respectively 6,545 feet, 6,275, and 6,012. The highest of these peaks is Mount Olympus. These heights were ascertained by triangulation. To the westward of these peaks the range gradually decreases, the highest peak south of Clallam Bay being 4,000 feet, and at Cape Flattery 1,000. All these mountains up to the snow line are covered with a dense and almost impenetrable forest. Innumerable rivers and streams of various sizes flow from these mountains into the Strait of Fuca on the north, into the Chehalis River on the south, into Hood's Canal on the east, and into the Pacific Ocean on the west, serving to drain a vast region of most excellent lands, particularly on the southern slope, where extensive prairies and a general rolling country easily cleared offer great inducements to emigrants in search of homes.

The basin containing the waters of Puget Sound, which are now understood to mean all those waters included between Budd's Inlet, the extreme southern portion, and Cape Flattery at the entrance to Fuca Strait, is bounded on the west by the region just described, and on the east by the Cascade Range of mountains, also covered to the limit of perpetual snow with the same magnificent forests, which are traversed by ten rivers which flow down from the Cascade Mountains and empty into the sound, furnishing ten alluvial valleys of agricultural land and supplying for logging purposes nearly a thousand miles of inland shore line.

Of the rainfall of the region west of the Cascade Range I will quote from a paper on the meteorology of the region lying west of the Cascade Range of mountains, which I prepared for the Academy of Natural Sciences at Olympia, W. T., which was also read before that society on the 18th of March last, in which I show from my own personal observations as well as from the official records, which are shown in the report of the Smithsonian Institution on the annual precipitation of rain in the United States (No. 222 Contributions to Knowledge), that the rainfall varies considerably in different localities on Puget Sound.

At Neeah Bay, at the entrance of the Strait of Fuca, the mean annual rainfall is 123.35 inches, which is greater than that of any recorded place on the American continent except Vera Cruz, in Mexico, where 183.20 inches are recorded as having fallen in 1830. As we come up the Strait we find the rainfall decreases thus: At Esquimault B. C., the mean annual precipitation is 65 inches; at Victoria, 60 inches; at Frazer River, 61 inches; at the American Camp on San Juan Island, 27.53; and at Port Townsend, 13 inches. The last is from the observations of the tidal observer at the

wharf at Port Townsend for the United States Coast Survey. This will probably differ from the records kept at the military post at Fort Townsend, where there is, I think, a greater rainfall which increases both at Chemakum and Port Discovery, although at the two latter places no official records have been kept. At Bellingham Bay, as shown by the records kept at Fort Bellingham in 1858, the mean rainfall was 29.67; at Steilacoom, 43.48; and at Olympia, although I have no data to refer to, I am informed that the rainfall is in excess of that at Steilacoom. The causes which operate to produce this great dissimilarity in the meteorology of Puget Sound are set forth at length in the paper I have alluded to, but their length will prevent me from giving a detailed description. I may, however, add that my views were adopted by the Academy of Natural Sciences as authentic and satisfactory.

A subject of great interest to this Territory is the climatic influence exerted by our forests, and what results are likely to follow the *disboscation* or clearing away of these forests.

The action of forests on the climate of a country is very complex, and there does not appear to be much unanimity of opinion among scientists on the subject, from wan of a general and extensive study of the phenomena. Such scientists as Arrago, Gay-Lussac, Beugnot, Gasparin, Schübler, Humboldt, Bonpland, Dutrochet, &c., equally vary in their opinion; in fact, it would be almost impossible to bring less proof to the solution of a question. And if so much uncertainty rests upon the decision of the European scientists, how much more so may be said of any conclusions we may arrive at respecting the climate of Washington Territory, where comparatively nothing has been done in the way of scientific observation! This much, however, may be said with certainty, that but little apprehension need be felt that the forests of Western Washington Territory will ever be extinct, although the timber trees may, after a long series of years, become as scarce as those of the State of Maine.

It is a well-known fact that the fir of Puget Sound has a wonderful vitality and tenacity, as may be seen in numberless instances. Where the forests have been cleared by the ax or swept away by destructive fires, or even in clearings that have once been cultivated and subsequently abandoned, the fir again springs up and in an incredibly short space of time entirely covers the ground with an impenetrable thicket. Our forests in this respect differ from those of New England. There the pine forest is succeeded by the oak and other deciduous hardwood trees, but with us fir succeeds fir. Whether this fact is of any value in deciding the question of the climatic influence our forests exert, cannot now be decided; and any solution of the problem can only be a theoretical one until sufficient time shall have elapsed and a great number of reliable observations made from which facts may be deduced which will enable us to arrive at certainties.

I have endeavored in this brief manner to answer the various questions contained in your letter which really require an elaborate essay to fully elucidate all that may be said upon the subject, but I trust that even these remarks may be of service to you in enabling you to prepare a more detailed statement for the honorable Commissioner of Agriculture.

Appended will be found a tracing of a skeleton map of this department. It shows the location of the posts, and gives an idea of the drainage of the country.

Very respectfully, your obedient servant,

(Signed) EDW. MAGUIRE,

First Lieutenant of Engineers, U. S. A.,

Chief Engineer Department of Dakota.

DEPARTMENT OF THE MISSOURI.

HEADQUARTERS DEPARTMENT OF THE MISSOURI,
OFFICE OF THE CHIEF ENGINEER,
Fort Leavenworth, Kans., March 26, 1878.

To the CHIEF OF ENGINEERS, U. S. A.:

SIR: In obedience to request contained in your letter of September 25, I have made efforts to obtain information on the question of forestry areas and conditions in the vicinity of the various military posts of this department. From some of these posts full and clear reports have been received, and from others reports that have not been so satisfactory,

either because too much has been undertaken from a misunderstanding of the instructions given or for some other reasons given in the reports inclosed.

I have not attempted to give a summary of the results obtained, because I have hardly received material sufficient in quantity or adapted in quality to such an analysis. I therefore forward herewith these reports for the information of the Commissioner of Agriculture himself. The reports inclosed have come from the commanding officers of the following posts: Forts Riley, Kansas; Reno, Camp Supply, and Gibson, Indian Territory; Lyon and Garland, Colorado; Bayard, Craig, Selden, and Wingate, New Mexico.

It is also requested that in forwarding these documents to the Commissioner of Agriculture a copy of my last annual report be sent, together with copies of sheets Nos. 2 and 4 Department of the Missouri map, and a copy of my map of the Indian Territory.

Very respectfully, your obedient servant,

E. H. RUFFNER,
First Lieutenant Engineers.

KANSAS.

FORT RILEY.

Captain T. E. Rose, Sixteenth Infantry, reports:

I have the honor to state, in reply to your communication of the 29th ultimo, that any information relating to the forestry, rainfall, &c., of this region, must necessarily be imperfect and unsatisfactory.

In regard to the rainfall, I can only refer you to the report of Surgeon C. C. Gray, United States Army, which is herewith transmitted.

In regard to the forestry, I have no data from which to give you the required information except my own observation, which is imperfect, from the fact that I have given the subject no attention further than for purposes of hunting, and the discovery of roads, paths, and divides, over which this region can be most easily traversed. As a result of this observation, I have found that, in all the old gulches or cañons leading from the tops of the high bluffs in the vicinity of the rivers and streams, there is a tolerably thick growth of oak and valuable timber, interspersed with a few maples, cottonwoods, and other species. These gulches or cañons have generally an area from one-fourth to one-half mile in length, and an average of about fifty yards in width, and from one-half to one and two miles apart.

On the bottoms of the rivers there is, in many places, a scattering growth of timber, generally of the same kind as that found in the cañons. I have noticed in a few places on the river bottoms where there are bodies of timber of several hundred acres in extent—one about nine miles from this post in the direction of Milford, on the Republican River; another right opposite this post, in what is called the bends of the Smoky Hill River; another in the bend of the Kaw River, six miles from here, in the neighborhood of Ogden and Manhattan.

On all the large creeks extending into the rivers there is also a growth of timber. None of the timber in this region is large and stately, but is rather low, spreading, and scraggy; neither is there any body of timber in this region that can be denominated a forest; nor will the timbered land embrace more than one-fiftieth of the whole extent of this region as far as it has come under my observation.

In regard to the elevation, I have no means of obtaining it, either barometrically or otherwise, nor do I find it anywhere given, except in the medical report of the hygiene of the United States Army, with description of military posts, and this work is already in your possession.

INDIAN TERRITORY.

FORT RENO.

Major J. K. Mizzur, Fourth Cavalry, writes as follows:

In compliance with request contained in your letter of September 29, I have the honor to forward herewith a report of the forestry and map of country in vicinity of this post. (See map of Indian Territory.)

The elevation is not exactly known, but supposed to be 2,000 feet above the level of the sea.

There have been, during the past year, heavy and continuous rains in this country but the post is not supplied with the necessary apparatus for determining the amount, it can be approximated to by taking the amount of rainfall at Fort Sill.

The fieldnotes of the United States survey of this country, it is presumed, would furnish valuable information in regard to the forestry, elevation, &c.

Lieutenant H. SWEENEY, Fourth Cavalry, reports as follows:

In connection with the report of forestry embracing the country between the Washita River and the Cimmaron, and about forty miles east and west of Fort Reno, the general character of the timber on the Washita River is cottonwood from Fort Cobb to Elm Springs, sparsely interspersed with walnut and oak, and a little ash. What there is of the walnut and oak is generally large for this country, averaging 18 inches in diameter; the ash is of a much smaller growth.

From Fort Cobb, west, the walnut and oak timber become much more scarce, until finally nothing but cottonwood is found. All the tributaries of the Washita are fringed with cottonwood. From five miles east of the Reno and Sill road and south of Boggy Creek, on the divide between the Canadian River and the Washita River, and running west to within about ten miles of the trail from Cobb to Supply, there is a heavy belt of post-oak, suitable for telegraph poles, railroad ties, or fuel. This belt of timber has an average width of two miles. The valley of the Canadian River has a thin fringe of cottonwood, having at a few places clumps of walnut and oak, about the same in quality as that on the Washita River. The tributaries of this river (Canadian) are fringed with cottonwood, very sparsely interspersed with elm and and hackberry of very small growth, and of very little utility except for fuel.

About twenty-five miles west of Reno, there is a very heavy belt of post-oak on the divide between the Canadian River and the north fork of the same river, extending west about fifty miles, and suitable for telegraph poles and railroad ties. This belt of timber has an average width of one and a half miles. A great many of the brakes of the tributaries of the Canadian River, on the north side, have a quantity of cedar timber which would make good telegraph poles.

The timber in the valley of the North Fork of the Canadian is confined to the river banks, and is composed almost entirely of cottonwood, in some places of very heavy growth. A peculiarity of the North Fork of the Canadian is that for over 200 miles there are no tributaries on the north side of the river.

Commencing about Caddo Springs, on the road leading from Reno to Wichita City, Kans., there is a belt of post oak of an average width of one and a half miles, extending for seventy-five miles up the river, northwest, interspersed with white oak, suitable for small saw-logs, telegraph poles, and railroad ties. At the heads of nearly all the brakes, on the north side of the divide, between the North Fork and the Cimmaron River, there is a good deal of cedar suitable for telegraph poles.

FORT GIBSON.

Captain C. R. LAYTON, Sixteenth Infantry, reports as follows:

At time of the receipt of your communication I had hoped to make an early report, founded upon information to be obtained from persons conversant with different parts of the Territory, as well as upon personal observation of a considerable portion of the Cherokee Nation. My own observations, however, have been confined to the country in the vicinity of the post, and also a part of the line of the Missouri, Kansas and Texas Railroad, nor had I, until December last, been able to obtain from others such information as to enable me to make a report in reference to the different matters inquired of by you. In the early part of that month, Hon. William P. Ross, ex-chief of the Cherokee Nation, at my request, addressed me a communication containing a description of the forestry of the country, a copy of which is inclosed as a part of this report.

In the latter part of last month I called upon the Indian agent near Muskogee, Dr. Marston, to obtain information from him in reference more particularly to the eastern part of the Territory. He was absent from the Territory when I received the description of the country sent me by Colonel Ross, and so remained until a few days before I saw him. He stated that his clerk, Mr. J. G. Vore, then absent, was a native of and thoroughly acquainted with all parts of the Territory. Leaving a note for Mr. Vore requesting information upon the different points inquired of by you, I, a few days ago, received from him a description of the country, which I also inclose as a part of this report. The communication of Colonel Ross is as follows:

"I am not able to reply with much exactness to your request for information respecting the forestry of the Indian Territory, particularly in regard to the extent of the forest area. Relatively, the largest areas are within fifty miles of its eastern borders.

There are, however, considerable belts of timber on some of the hills and along the larger water courses for a like distance, or even greater, further west. The largest areas of timber in the Cherokee country are between the Grand and Arkansas Rivers on the west and the State of Arkansas on the east. Timber of considerable extent is also found on the Verdigris and Canadian Rivers and some of their tributaries within the same nation.

"There are two principal lines of drainage: the first is formed by the Arkansas River and its tributaries. Of the latter, on its northern side, mention may be made of the Verdigris, the Grand and Illinois Rivers, and the Sallison and Deer Creeks; and on its southern side, the Canadian and Sans-Bois. The second line is that of the Red River and its confluents from the north, which drain the southern portions of the Choctaw and Chickasaw Nations. The growth on the hills and uplands embraces, according to locality, hickory, pine, post and red oak, and the usually small and scrubby variety known in the familiar language of the country as 'blackjack,' and which perhaps covers a larger extent of country than any other single variety. Sugar-maple and white oak are also found in some parts of the country. Three varieties of hickory are found, known as the white, black, and scaly bark. In the bottoms and low lands are sycamore, soft maple, walnut, pecan, ash, cottonwood, elm (three kinds), several varieties of oak, lynn, birch, wild cherry, willow, coffee-bean, locust, and red birch. There are also found red cedar, chincapin, black gum, persimmon, pawpaw, wild plum, and various other trees of small growth, and shrubs. The pine, which is of the kind known as yellow or pitch pine, is in the Cherokee and Choctaw Nations. In the former the pineries are within thirty miles, more or less, of the Arkansas State line, and are in the hills bordering on the Grand and Illinois Rivers, and Spavina and Lee's Creeks. Those in the Choctaw Nation, I am informed, are also in its eastern portion. As there have been several saw-mills in operation for a number of years in the Cherokee pineries, which have not been regarded as of much extent, their capacity for yielding lumber is materially reduced. The same remark, to a less degree, may apply to the Choctaw pineries. The black walnut is frequently of larger growth and superior quality for shingles and furniture. The pecan is also of large growth, and besides yielding its rich and valuable nut, makes excellent clapboards, fire-wood, and implements for which the hickory is so much prized on account of its toughness and elasticity. The post, white, black, and overcup oaks are also frequently of large growth, and are used for rails, house-logs, boards, and farming implements. Cottonwood is of rapid growth and attains large size. It is used for rails, but is not much valued for any purpose. It is, however, the principal growth found on the streams after proceeding a hundred and fifty miles or so west from this place.

"The Cherokees have laws designed for their protection of their timber, and which have been reasonably effective except on the Kansas border. Depredations there are reported as having extended several miles (eight or ten) into the nation. Notwithstanding this, however, and the considerable quantity of timber used for railroad ties and building purposes, I am of the opinion that the forest area is constantly extending in this country, and that the supply is ample for all the wants of the people, although it is not so generally distributed over fertile and desirable portions of the agricultural lands as would be available and profitable."

Mr. Vore, in his communication, says:

"This Indian country, measured with the eye, is about four hundred miles from east to west, and about two hundred and fifty miles from north to south. From the eastern boundary, about 94°.50 west longitude, to the 97th degree, at least two-thirds of it is forest. From the 97th degree to the 100th the western boundary is nearly all prairie. A small skirt of timber, or rather a skirt of small timber, commencing south of the South Canadian River and running south, known as the Upper Cross Timbers, which is about 97°.50 west, and small skirts along the rivers and water-courses, is about all there is west of 97°. The forest in the eastern portion is principally of oak. It is the heaviest and largest in the valleys of the rivers and creeks, and consists of overcup, red, black, and water oaks. There is also in these valleys the cottonwood, elm, pine, ash, black walnut, hackberry, box-elder, cedar, and birch. On the hills and mountains the timber is mostly post and blackjack oak. There is also some pine on the sides of the mountains, principally in the Choctaw country and in the southeastern portion of it; it is also found in the flats, none, however, west of 96°. North of the Arkansas there is none west of the hills bordering on the Grand River. As I stated, the forests in the eastern portion of the country are the largest, tallest, and densest, gradually growing smaller, shorter, and more scrubby, unsound and more wind-shaken, until you reach the plains. Much of the post-oak timber is unsound. The largest bodies of cedar are in the valleys of the Canadian and Arkansas Rivers, are full of limbs and knots, fit only for posts.

"Four-fifths of the country is drained by the Arkansas River and its tributaries, and about one-fifth by the tributaries of the Red River. Commencing at the eastern boundary, near the Red River, you have the Little River with its mountain, and Rolling Forks, heading in the State of Arkansas, running southwest into the Choctaw

country, then sweeping around back into Arkansas again, and emptying itself into the Red River. Next is the Kiamitia, the Boggys, Blue, and False Washita Rivers, the Mud, Walnut, Beaver, Caché, and other creeks below and around the Washita. North of the Arkansas River is first the Lee's Creek, Skin Bayou, the Sallison, Vienne, Illinois, Greenleaf, Bayou Manard, Grand and Verdigris Rivers. On the south of the Arkansas River is first the Poteau, with its Brayils, Fouch Malines, Sugar Loaf, and other tributaries; then Cazier, Sans-Bois, Canadian, Derdenne, Red Fork, Black Bear, Rio Negris or Salt Fork of the Arkansas. The principal streams running into the Canadian River from the south are first what was once known as Gaines Creek, then the South Fork of the Canadian, now known as Gaines Creek, which heads and laps around among the mountains at the head of the Sans-Bois, Fouch Malines, Kiamitias, and the Boggys. The next west of Gaines Creek of any size is Walnut Creek, which heads in the Upper Cross Timbers, emptying itself between that and the Lower Cross Timbers, the upper edge of which is about 97° west. On the north side of the Canadian are the North Canadian and Little Rivers, the last of which heads in the plains west of 97°. The Deep Fork is a river running in the plains east of the Arapahoe and Cheyenne Agency, and almost within a mile of the North Canadian, running north to within about eight miles of the Red Fork of the Arkansas, when it sweeps round to the east, emptying itself into the North Canadian about nine miles above its junction with the main Canadian, draining nearly all the country between the North Canadian and the Red Fork of the Arkansas. Rains frequently cause it to overflow its banks and remain full and past fording for weeks.

"The timber bordering on the plains from the Arkansas River south, known as the Lower Cross Timbers, is principally of post oak and blackjack, small and scrubby. In the valleys of the Canadian, Little River, and Deep Fork is some oak timber of considerable size—from two to four feet in diameter—but the quantity is small.

"What the elevation of the country is I am not informed, nor am I of the amount of rainfall; it varies with the years, and is as uncertain and variable as the climate. It is much greater in the mountainous and timbered portions of the country than on the plains. From the 97th degree to the 100th degree the country is much more subject to drought than east of it, generally commencing the latter part of June. The South or main Canadian, west of the Little River, which is about 96°, is very frequently almost dry; what little water remains on the surface stands in small ponds, and you can ride for days in its dry, sandy bed. It heads north of Santa Fé, in the Rattoun Mountains, and is, I understand, a bold running stream there; when it reaches the plains I know it sinks, and is frequently as I have described it. The North Canadian heads in the plains and has very few tributaries, the Deep Fork draining the principal portion of the country and is the only tributary it has of any size."

Besides the gentlemen from whom I received the above information, I have conversed with others who have had opportunities of knowing the country, or different parts of it. The descriptions I have obtained agree substantially with those already given. Some with whom I have spoken have differed somewhat from Mr. Vore in his estimate of the forest area of that portion of the country between Grand River and a line running south from this point and the 97th degree, thinking that the forest area will not exceed one-half of that portion of the Territory.

It is said that yellow pine is abundant in the eastern and southeastern parts of the Choctaw Nation, and very valuable.

The pecan-nut affords quite a valuable crop in the Territory, that in the Creek Nation alone being worth in a year of ordinary bearing $18,000.

The rainfall during the last three years, as ascertained by the pluviometer at the signal station in the village of Fort Gibson, adjoining this, has been as follows:

Years.	Average per month.
1875	3.15 inches.
1876	2.96 inches.
1877	3.90 inches.

The altitude of this post is 619 feet. In the records at the post hospital the altitude is stated to be by barometer 600 feet. This was corrected at the signal station, making it 619 feet.

CAMP SUPPLY.

Major H. A. HAMBRIGHT, Ninth Infantry, reports as follows:

In compliance with the requests made in your letter, duplicated January 10, 1878, you will please find below a list of trees, shrubs, and undershrubs at and near the post of Camp Supply, Indian Territory. The extent of area embracing this growth is about twenty-five miles. The lines of drainage are all in the direction of southeast by south. The only record at this post of the elevation is that taken by Lieut. E. H. Ruffner, United States Engineers, obtained April 30, May 1 and 3 inclusive, 1877. The rainfall

for the year 1877 and for the months of January and February is also given below. All, or nearly all, of this information has been obtained from Assistant Surgeon T. E. Wilcox, United States Army, in charge of post hospital:

List of trees, shrubs, and undershrubs at and near Camp Supply, Indian Territory.

MELIA.—*M. Azederach*—Pride of India.
RHUS.—*R. glabra; R. radicans; R. toxicodendron; R. aromatica.*
GYMNOCLADUS—Coffee Tree.—*G. Canadensis.*
ROBINIA—Locust.—*R. pseud-acacia.*
MIMOSA—Mimosa.—*M. fragrans.*
ACACIA—Mesquite.—*Mesquite.*
PRUNUS—Plum.—*P. Americana; P. chicasa.*
RIBES—Currant.—*R. aureum.*
CORNUS—Dogwood.—*C. sericea; C. paniculata.*
CEPHALANTHUS—Button Bush.—*C. occidentalis.*
SYMPHORICARPUS—Coral Berry.—*S. vulgare.*
ULMUS—Elm.—*U. racemosa.*
CELTIS—Hackberry.—*C. occidentalis.*
JUGLANS—Walnut.—*J. nigra.*
QUERCUS—Oak.—*Q. Emoryi; Q. nigra.*
SALIX—Willow.—*S. humilis; S. candida.*
POPULUS—Cottonwood.—*P. angulata.*
JUNIPERUS—Cedar.—*J. Virginiana.*

Rainfall for the year 1877 *at Camp Supply, Indian Territory.*

	Inches.		Inches.
January	0.34	August	2.82
February	1.04	September	1.40
March	0.00	October	4.04
April	1.53	November	1.70
May	8.45	December	7.58
June	3.57		
July	0.91	Total	33.53

January, 1878	0.26
February, 1878	0.53

NEW MEXICO.

FORT SELDEN.

Lieutenant T. F. DAVIS, Fifteenth Infantry, reports:

In New Mexico the extent of forest area is comparatively small; timber for all purposes, excepting, perhaps, for shade, being obtained from the mountains. I am unable to state the approximate area for the whole or any part of the Territory.

In this vicinity the nearest timber lands of which I have any knowledge are situated in the San Mateo, Miembres, Mogollon, and Burro Mountains, west of the Rio Grande, and the Sacramento Mountains, on the east. Good timber is also plentiful on all the other ranges, though not in this vicinity.

On the foot-hills bordering the plains nothing grows beyond small bushes, and the same is true of the mesas and plains. In the lowlands, on the Rio Grande and numerous small streams called "rios," the cottonwood grows densely, and is the principal timber, but is scarcely reckoned as fit for any purpose but firewood and shade.

In the ranges above mentioned as timber-lands, the leading variety found is pine, which equals in growth that of the States. In some parts cedar and piñon are found; the former very much stunted. The same may be said of the oak, of which there is but little, and that confined to northern localities. The varieties are few; pine, piñon, and cedar being the leading ones, and the only ones I have noticed.

There are no timber-lands bordering on plains here; the extent is very small, being confined to the mountains, and the condition and growth of all varieties of timber are poor, excepting for pine and piñon, which is no doubt due to the great want of water in this country. The plains and foot-hills being hard, dry, stony ground, would scarcely admit of anything growing on them, even with water, and many mountains often appear masses of solid rock, devoid of timber, and show no indications of ever having been covered with forests. It is only in places particularly

favored that timber is found in abundance, or in any way approaching a forest, as in the ranges mentioned.

Very few of the streams, draining the mountains where timber is found, are permanent; if they were, the want of trees and vegetation in general would not be so noticeable, especially in the south here. No streams appear to drain the Burro Mountains, but arroyos afford escape for water in all directions, probably reaching the Gila River on the west, and losing themselves in the ground on the east and southeast, the trend of the country being toward Mexico.

The Mogollons are drained by small streams running into the Gila on the west, and perhaps into the Miembres River east and southeast.

The Miembres and San Mateo Mountains are drained by numerous creeks, called "rios," which flow east into the Rio Grande, the land descending rapidly toward that river. The Sacramento group is drained by several small streams flowing east into the Pecos River. Taking certain places, of which the barometric elevation is known, as guides, I judge the timber-lands or forests above enumerated are situated above 4,000 feet from sea-level, and the best perhaps between 5,000 and 8,000 feet altitude.

In New Mexico the rains are periodic, occurring generally during the summer months, and late in September. Most rain falls in the mountains, as it is often perceived to rain there when none was falling on plains or near the rivers below 4,500 feet. I am unable to state the annual quantity for any year, no records of observations being on hand.

Saw-mills are located in the best districts. The scarcity of wood and water are perhaps the greatest difficulties to overcome in Southern New Mexico, and that, I should think, clearly indicates the absence of any forests, excepting in remote localities, or in the mountains away from inhabited towns."

FORT WINGATE.

J. V. LAUDERDALE, assistant surgeon, U. S. A., says:

This reservation is ten miles square, and lies partly on a northerly spur of the Zuni Mountains, and extends along the Rio Puerco, which drains the valley known as Campbell's Pass. A correct topographical map of this reservation, made by order of General George W. Getty, and surveyed by Capt. John Rizha, U. S. A., a copy of which is in the office of the post adjutant, exhibits the features of this reservation, and shows the forest area, and the lines of drainage. The post of Fort Wingate, N. M., is situated in latitude 35° 30′ north, and longitude 108° 32′ west, and its elevation above the sea, as determined barometrically by the engineer of the Kansas Pacific Railroad survey, is 6,649 feet. The amount of rainfall for the years 1875 and 1876 has averaged 11.18 inches.

The water from the mountain-side, which forms running brooks when it rains, and that from the several springs at its base, flow into the Puerco, but insufficient in quantity to sustain a running stream throughout the year or support a growth of trees along its banks. About one-half the reservation is comparatively treeless. A stunted growth of cedar (*Juniperas Virginiana*) covers the mesas and foot-hills of the Zuni Mountain. The dead and dry wood of this tree is collected for fuel. The piñon (*Pinûs edulis*) is also quite abundant on the mesas and foot-hills, and is better for fuel than cedar. It attains the height of twenty feet, and is regarded with favor by the Indians for its sweet and edible nut. No attempts have been made to grow the tree near here, but I am confident that it could be readily cultivated. Prof. H. L. Kindrick, at West Point Academy, sent to me more than a year ago for some of the nuts, with a view to propagating the tree at the east. The wood is excellent for fuel, and the tree would be suitable for shade, but it is wholly unfit for lumber or building purposes.

The yellow pine (*Pinôs brachyptera*) is found in abundance along the summits and southerly slopes and parks of the Zuni Mountain. This tree reaches the height of one hundred and twenty feet, and is from two to three feet in diameter at the base. It is cut for timber and is found to be very durable for building purposes, but boards made of it are better for being painted when used for outside work. It is too soft for posts or railroad-ties.

There may be seen scattered here and there, clumps of small white oak which bear a sweet acorn. One variety of oak reaches the height of thirty feet, and its wood is suitable for fence-posts. In the sheltered cañons we find specimens of the aspen (*Populus tremuloides*), also the willow-leaved poplar, which last I have found an excellent shade tree. It bears transplanting well, but requires irrigation. It grows well when set near a water-course.

Of the willow family the basket osier is the most frequently seen about this post.

The above is a list of the characteristic forest trees that are to be found upon this military reservation.

FORT CRAIG.

WILLIAM J. WILSON, assistant surgeon, U. S. A., makes the following report:

There are no forests in the immediate vicinity of this post. The country is arid, and but very little rain falls, supporting only a scanty vegetation. The only exception is along the river bottoms and in the high mountains.

On the banks of the Rio Grande cottonwood trees grow to a respectable size; the other natural growth consists of willows and mesquite bushes. The latter have immense roots, which are largely used for fuel. The cottonwood grows very rapidly; it will not make lumber, but is a beautiful shade tree, and answers most of the requirements in building and fencing.

The exact area of forest in this country I have no means to determine. In the foothills and mountains grow trees of good size, especially scrub oak, cedar, pine, spruce, ash, walnut, and piñon. The garrison of the post is supplied with scrub oak for fuel, which is obtained in the mountains about forty miles from the post. The wood is cut down mercilessly, and nothing whatever is done to keep up forests. The contractors have to go farther out in the mountains every year to get their supply of fuel. Pine timber in dimensions fit for building purposes (scantling, &c.), is to be obtained of good quality in some of the mountains, and there is one saw-mill in operation about forty miles from here.

The altitude of this post, as determined by Lieutenant Fillman barometrically a few years ago, is 4,619 feet. See annual report upon the geographical survey west of the 100th meridian in New Mexico, Arizona, &c., by G. M. Wheeler, first lieutenant of Engineers, U. S. A., page 13. No barometer is at my disposal. Formerly it was calculated at 4,576 feet, and was so carried on for many years in the meteorological register.

In the Rio Grande and the arroyos leading to it (tributaries which are always dry except immediately after heavy rains) drain the post and its neighborhood.

The rainfall for 1870 amounted to 9.14 inches; 1871, observations incomplete; 1872, amounted to 7.12 inches; 1873, amounted to 5.85 inches; 1874, amounted to 9.08 inches; 1875, amounted to 13.31 inches; 1876, amounted to 11.68 inches; which gives 9.35 inches as yearly average of rain. The average amount of the annual fall of rain west of the Mississippi River is 24 inches. Most of the rain, about 75 per cent., falls within the months of July and August, sometimes also in September.

The general want of forests in this country has a deteriorating influence on the climate. Extremes in temperature within twenty-four hours, stifling sand-storms covering everything with dust, and which sweeps over the country without any obstacles, uneven distribution of rain during the different seasons and its very limited amount during the year, are some of the effects of the wanton destruction of trees and forests, wherever found, which has been going on in this country for ages unobstructed.

FORT BAYARD.

Captain OSCAR HAGEN, Ninth Cavalry, reports:

Fort Bayard is inclosed on the north, east, and west by mountains extending a great distance in the three directions, but the south is open, over irregular, rolling, and rising ground. Pine, cedar, and scrub oak are found in quantities on the surrounding hills and mountains. Heavy timber for building purposes is plenty about twenty or twenty-five miles from the post, in the Miembres Mountains and along the Rio Gila, especially pine and heavy oak.

There is no timber on either side bordering upon the plains, except cedar and scrub oak. The lines and drainage trend generally north and south. The elevation is 5,322 feet, ascertained barometrically. The rainfall at this post has never been ascertained. Except during the rainy season, which lasts from about the end of June until the middle of September, there is very little rainfall.

During the rainy season there is rainfall nearly every day, sometimes torrents. The post is supplied with water from a constant spring, lined with a wooden casing, from which the water is conducted through wooden pipes, a distance of about 450 yards, to a tank, where the water passes through a filter of charcoal, and thence is delivered by water-wagons to the quarters of the post. The Rio Miembres and the Rio Gila are, respectively, 19 and 33 miles distant from the post. The country around is but little suited for agriculture, as the climate is so dry that vegetables and cereals can be raised only by irrigation, and the springs and streams available for this purpose are far distant from each other. It is much better suited for stock-raising, as the grass is in good quantity and nutritious for animals, and there is an immense range for cattle around and in the immediate vicinity of the water.

COLORADO.

FORT GARLAND.

Captain J. MORRIS BROWN, assistant surgeon, U. S. A., post surgeon, reports as follows:

The forestry of this particular locality is very limited in area, being confined to the borders of the streams intersecting the San Luis Valley, and the foot-hills and mountain-sides. The variety bordering the streams are mainly cottonwood and willow; and on the foot-hills and mountains, pines, piñon, aspen, and cedar, with some scrub oak and spruce. Few of these trees attain to any great size excepting the cottonwood and some pines, which furnish an inferior quality of building lumber, the other varieties furnishing excellent fuel. The drainage of the valley is naturally good and trends toward the south and west, the surface being gravel, through which water is reached only at a great depth.

The elevation of the site of this post is given at 7,681 feet above sea-level, and I understand that this altitude was ascertained barometrically by a party belonging to Wheeler's expedition, about two or three years ago. The valley has a gradual descent toward the south and west to the Rio Grande and the spur of mountains forming the southern boundary of the park. On the western side of the river there is a gradual rise to the San Juan range of mountains.

The climate is very dry, the yearly rainfall being very small in amount. For the past two years the rainfall, according to the meteorological register of the post hospital, has been as follows, viz: 1875, 11.56 inches; 1876, 7.50 inches.

FORT LYON.

Colonel C. H. SMITH, Ninteenth Infantry, reports:

The elevation of this post, as shown by the hospital records, is 3,800 feet altitude; is not known how or by whom obtained. The amount of rainfall since 1870 is as follows: 1871, 7.67 inches; 1872, 16.97 inches; 1873, 11.58 inches; 1874, 14.58 inches; 1875, 10 inches; 1876, 9.01 inches; 1877, till 1st of October, 9.53 inches. The country is rolling prairie, drained by ravines and small streams, which run southeast on the north side and northeast on the south side of the main streams into which they flow.

The forest area in the immediate vicinity of the post is small; in fact, there is no timber except what is growing on the banks of the large streams. The timber on the Arkansas River, commencing about forty miles east of the post, keeps increasing in size and area as you approach the mountains; but it is principally composed of scrub cottonwood, confined to the banks and islands of the river, and fit for nothing but fuel, until you arrive west of the Pueblo, when the pine makes its appearance.

The Purgatoire River, which flows into the Arkansas about one mile west of the post, is still better timbered with cottonwood than the latter, and its timber area increases as you approach the headwaters in the Raton Mountains, where some cedar is found.

The only large and valuable timber area in the near vicinity commences about seventy-five miles west of here, and is between this point and Denver, on a spur of the mountains known as the Divide. This is said to embrace thousands of acres of pine timber, from which valuable lumber is sawed and hauled to Pueblo on the south and the Kansas Pacific Railroad on the north.

FORESTRY PROPER OF THE COLORADO VALLEY.

(Extract from report of Lieut. A. G. Tarsin, Twelfth United States Infantry.)

First in order comes the scanty vegetation of the dry, sandy, and gravelly sides of the basin between the river-bottoms and the base of the mountain ranges forming the apex or upper edge.

This is composed of the *Larrea Mexicana*, the *Echinocactus cylindraceus*, and *Atriplex*, with here and there an isolated specimen of the *Yucca brevifolia*, or cactus palm, appearing principally in the "washes," which will be described further on.

As a general rule the vegetation, scanty at best, is always more plentiful and of a higher order in these depressions of the soil than in the higher and general plane of the surrounding country.

In the lowlands, in the immediate vicinity of the river and its own progeny, or, more properly speaking, its own products, the water, spreading through the temporarily accumulated soil, keeps it moist and more favorable to vegetation, which springs from it in luxuriant wildness.

The first species to appear are, generally, the *Bouteloua sesleria*, or mesquite grass, then the peculiar grass or fiber yclept "Tanglefoot," and the *Gallete*, or rough bunch-grass, the least nutritious of the trio. At this stage the *Juniperus*, properly belonging to the flora of Arizona, begins to enliven the scene.

Thick groves, or plantations, if not a misnomer, of the different species of the arrow-weed, the *Salix longifolia*, *Tessaria borealis*, *Baccharis coerulescens*, and *Baccharis salicina*, stand out as if sown like wheat-fields, the somber and dusty tints of their leaves trenching in bold relief upon the brighter green of other shrubs.

Interspersed here and there among these we find the two species of the mesquite tree, the *Algarobia glandulosa* and the *Strombocarpa pubescens*, and finally, along the margin of *lagunas*, the most substantial of the *Colorado timber*, the willow and cottonwood.

The largest of these last, in the entire course of the river, are on what is called "Cottonwood Island," between Camp Mohave and the Grand Cañon, where they have attained a size which may be styled majestic, when the nature of the surrounding country is taken into consideration; and this is due to the permanent nature of the island, upon which they have been allowed to attain their full size.

The cottonwood, mesquite, and willow are the principal, if not the only, fuel of the country; the first having a diameter varying from 10 to 20 inches when they do not reach maturity; the two last from 4 to 10 inches.

To sum up, the principal growths of the entire region may be tabulated as follows:

Atriplex hymenelytra.	*Atriplex polycarpa.*	*Palafoxia linearis.*
Psathyrotes ramosissima.	*Physalis lobata.*	*Lippia cuneifolia.*
Aster spinosus.	*Sesbania macrocarpa.*	*Abronia.*
Pluchea Sarcostemma.	*Algarobia glandulosa.*	*Strombocarpa pubescens.*
Salix longifolia.	*Tessaria borealis.*	*Baccharis coerulescens.*
Baccharis salicina.	*Malvastrum Marrubioides.*	*Datura meteloides.*
Cucurbita Californica.	*Xanthium Strumarium.*	*Suæda diffusa.*
Panicum crusgalli.	*Chloris alba.*	*Allionia incarnata.*
Populus monilifera.	*Lygodesmia.*	*Cercidium floridum.*
Dalea spinosa.	*Chilopsis linearis.*	*Krameria parvifolia.*

For the purpose of elucidation, the entire region comprised between Stone's Ferry, Nevada, and the river mouth in Mexico has been divided into section-sketches, as follows: 1st, *Section of Stone's Ferry;* 2d, *Section of Cottonwood Island;* 3d, *Section of Mohave;* 4th, *Section of Aubrey;* 5th, *Section of Ehrenberg;* 6th, *Section of Yuma;* 7th, *Section of the mouth,* together with a *sketch of a section of the general valley,* showing what may be considered a fair average of the vegetation and wooded area, together with an attempt at demonstrating the gradual formation and washing away of the bottom-lands and the general conformation and aspect of the surrounding country.

APPENDIX.

Table of rainfall at Fort Buford, Dakota, from August, 1866, *to November,* 1877.

Month.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.
January	......	......	.26	......	.32	.21	3.76	.98	.15	.71	.13	.31
February	......	......	.13	.38	.31	.19	......	4.35	.20	1.12	.12	......
March	......	......	.02	.46	.41	.15	1.25	2.25	.25	.73	.09	.11
April	......	.03	.33	.65	......	.45	1.55	1.25	.15	1.83	.10	.13
May	......	.42	1.79	1.78	3.91	2.43	1.12	6.60	1.80	1.39	4.00	4.48
June	......	1.27	3.21	.86	.77	.90	1.75	2.73	1.02	3.46	1.75	2.04
July	......	2.94	1.97	1.62	.76	.55	2.45	......	.24	1.48	......	.80
August	1.20	.54	2.39	.97	.81	.10	1.45	1.40	2.26	3.05	3.95	......
September	.20	.10	.26	2.47	.45	......	3.25	1.10	.25	.43	1.05	.85
October	......	.14	.62	......	1.25	.72	.80	.45	.13	.45	.80	1.20
November	......	.51	.13	.55	.03	1.20	1.04	......	.83	.20	.21	......
December	......	.63	.39	......	.17	2.52	1.57	......	.30	......	.13	......
	1.40	6.58	11.50	9.74	9.19	9.42	19.99	21.11	7.58	14.85	12.33	9.92

ABSTRACT A.

Mean temperatures and rainfall at Fort Rice, Dakota, from May 11, 870, *to October* 31, 1877.

Year.	Rain and melted snow in inches.	Mean temperature.	Remarks.
1870, May to November, 8.59 inches rain......	8.72	53.95	Eight months' observations, from May to December.
1871, April to November, 12.67 inches rain....	12.59	37.16	
1872, April to November, 11.51 inches rain....	13.40	40.00	
1873, April to November, 7.82 inches rain....	10.81	38.00	
1874, April to November, 7.72 inches rain....	13.94	43.81	
1875, April to November, 12.49 inches rain....	16.16	39.42	
1876, April to November, 10.28 inches rain....	11.50	42.68	
1877, April to November, 19.58 inches rain....	26.53	49.50	Ten months' observations, from January to October.
Mean for seven and a half years........	....	45.70	
Total rainfall in seven and a half years..	113.63	....	

Latitude, 46° 35′; longitude, 23° 33′; elevation above sea-level, 2,200 feet.

BLAIR D. TAYLOR,
Assistant Surgeon, U. S. A.

The rainfall for 1871, as recorded, is probably erroneous.

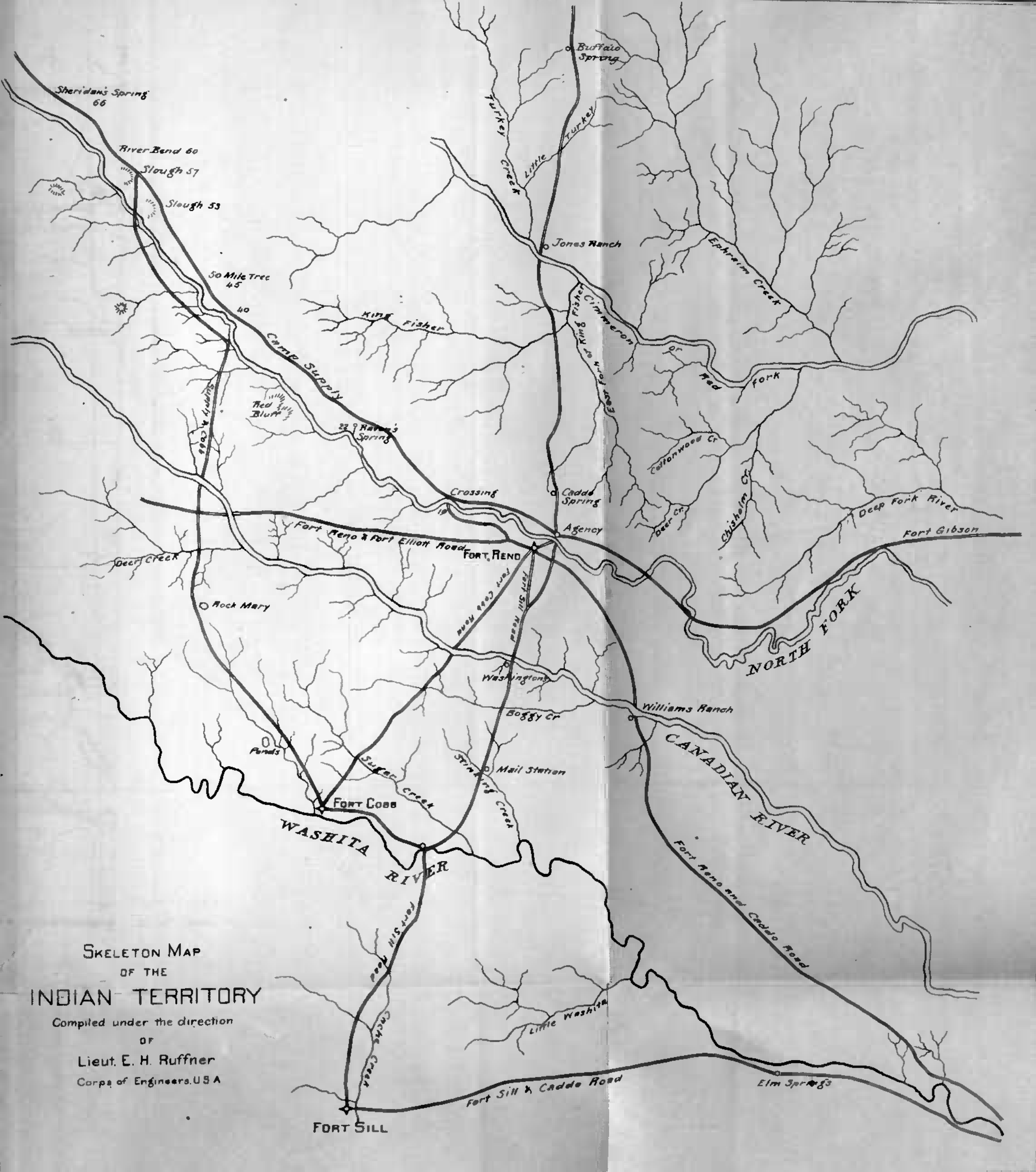
EDW. MAGUIRE,
Lieutenant Engineers, U. S. A.

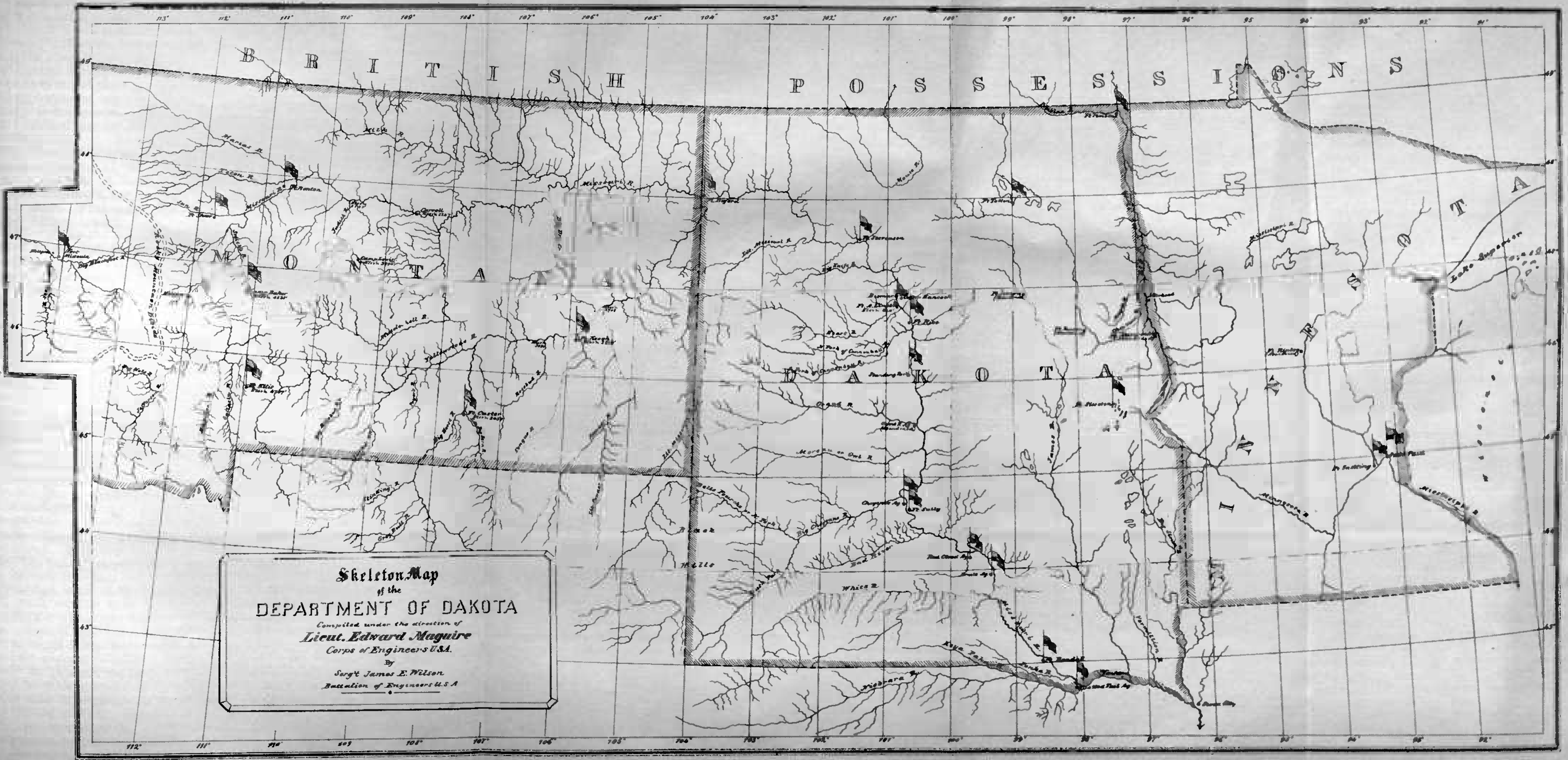
THE CORK TREE.

Mr. Primitivo Artigas y Teixidor, a graduate of the School of Forest Engineers of Spain, has recently published a pamphlet* on the culture of the cork tree and the care and management of cork plantations. As the climate in many parts of the United States is known to be favorable for the growth of this tree, it is deemed expedient to give the following summary of Mr. Artigas' pamphlet. It is to be regretted that lack of space forbids the presentation of a full translation of the work, which also contains a paper on the manufacture of bottle-corks in Spain.

According to Mr. Artigas, up to the present day no material has been found to take the place of cork in the manufacture of stoppers for bottles. Its impermeability, elasticity, durability, and lightness have gained for it a position in the field of industry which it will not readily yield to any other substance. Hence the imperative necessity for encouraging the growth of cork plantations, and avoiding the course followed by some operators in this branch of forest industry in the island of Sicily, the kingdom of Naples, and in the island of Sardinia. In the last-mentioned place a cork plantation, according to Mr. Nicholas Eymar, capable of yielding an annual income of five or six hundred thousand francs was destroyed. The object was to obtain the tannin from the bark. The trunks and branches of the trees, after having been stripped of their bark, were burned in order that the carbonate of soda contained in the ashes might be extracted. To-day, and with good reason, the manufacturers are beginning to fear that there will soon be a great scarcity

*El Alcornoque y La Industria Taponera, por Don Primitivo Artigas y Teixidor, Ingeniero de Montes. Madrid, 1875.


Sheridan's Spring 66
River Bend 60
Slough 57
Slough 53
50 Mile Tree 45
40
Camp Supply
Red Bluff
22 Raven's Spring
Crossing
19
Buffalo Spring
Turkey Creek
Little Turkey
Jones Ranch
King Fisher
Ephraim Creek
Cimmeron or Red Fork
East Fork of King Fisher
Cottonwood Cr
Caddo Spring
Agency
Deer Cr
Chisholm Cr
Deep Fork River
Fort Gibson
Fort Reno & Fort Elliott Road
FORT RENO
Deer Creek
Rock Mary
Fort Cobb Road
Fort Sill Road
NORTH FORK
Washingtons
Boggy Cr
Williams Ranch
CANADIAN RIVER
Ponds
Sugar Creek
Stinking Creek
Mail Station
FORT COBB
WASHITA RIVER
Fort Reno and Caddo Road
Fort Sill Road
Cache Creek
Little Washita
Fort Sill & Caddo Road
Elm Springs
FORT SILL
SKELETON MAP
OF THE
INDIAN TERRITORY
Compiled under the direction
OF
Lieut. E. H. Ruffner
Corps of Engineers. U.S.A.



BRITISH POSSESSIONS
DAKOTA
Missouri R.
Yellowstone R.
White R.
Niobrara R.
Bad River
Big Cheyenne R.
James R.
Lake Superior
Mississippi R.
Minnesota R.
Skeleton Map
of the
DEPARTMENT OF DAKOTA
Compiled under the direction of
Lieut. Edward Maguire
Corps of Engineers U.S.A.
By
Serg't James E. Wilson
Battalion of Engineers U.S.A.

of fine cork for stoppers if the cork plantations are not looked after and managed with more care and attention than heretofore. The demand for bottle-corks is rapidly growing larger, and everything leads to the belief that it will continue to do so for many years. The establishment of cork plantations, however, goes on very slowly. Fully aware of this fact, the French Government, in 1822, placed in the hands of the Royal and Central Society of Agriculture 4,500 francs, to be divided among such persons as might plant acorns of the cork oak after the year 1823, and at the expiration of ten years possess plantations containing ten thousand strong and vigorous saplings. In 1834 three persons were found to have fulfilled the conditions, and the money was divided among them by the society.

The French Government pays particular attention to the preservation and development of the extensive plantations of this tree which now exist in Algeria. A large and intelligent staff of officers, of the corps of forest engineers, have charge of them, and they yield a large revenue to the state. France has now about 500,000 acres of cork plantations in her African colony.

Although in the majority of cases the offer of prizes, always small and of little value, for the culture of a tree which requires a heavy expenditure to plant the seed, and a long period to acquire the requisite size, is inefficacious, it might, perhaps, be productive of much good to call a convention of proprietors of cork lands, to be held within six, eight, or more years, to discuss the question of cork culture. One or more premiums might at the same time be offered to those who should, within the time specified, obtain the best results in planting, or in the improvement of their lands. The awards should be made by a select jury so as to secure impartial and intelligent decisions.

It would also not be out of place to offer a handsome prize for the best paper on the destruction of the larvæ which are now doing so much damage to the cork by burrowing through it in all directions; and another for the best paper on the means of preventing the appearance of the disfiguring stains in the cork known as "*jaspeado*" (mottled). With this incentive a desire to study these questions, upon which so little is now known, might be awakened, and it is fair to assume that a positive benefit would result.

The importance of the cork crop and the development of the manufacture of corks in Spain were hardly appreciated until about the middle of the present century. Since that time the latter has increased enormously, and to-day, in some provinces, it is one of the chief sources of wealth. Hence the great rise in the value of cork within the period mentioned. Formerly used in making beehives and floats for fishing-nets, &c., but principally for fuel, its money value was insignificant. As the cork tree does not furnish good lumber, and its wood is valuable only as fuel, some of the proprietors of cork plantations desiring to obtain better returns from their lands, devoted them to other purposes, and in this way, even during the second third of this century, large plantations of cork trees were cut down. On account of the low estimation in which it was held, there was, up to a short time ago, no inducement for any one to make a study of the cork tree with a view to improve its product or increase its yield. Unfortunately, persons who might have done so did not even take it up as a scientific curiosity.

The little information of importance that has been published upon this subject is of very recent date. The time, also, employed in the experiments mentioned by the different writers has not been sufficient, in many cases, to prove practically that which has been theoretically ad-

vanced, or positively stated as being beyond dispute. All facts bearing upon the question, therefore, should be scrupulously and methodically collected in order to be used as a basis for the formation of rules for the guidance of all engaged in cork culture.

The cork tree (*Quercus suber*, of Linnæus) is of various sizes, and this has given rise to wide differences of opinion with respect to the greatest height and circumference or diameter it attains. According to Mr. H. Laure some have grown to the height of fifty feet, and he has seen trees of three feet in diameter in the neighborhood of Bormes. Mr. F. Jaubert de Passa fixes the maximum height at sixty feet with a diameter of four feet. In Algeria cork trees sixty-five feet high and from ten and a half to sixteen and a half feet in circumference have been found.

In Estremadura there are some trees as large as those found in Algeria. There is a tradition that in the valley of Batuecas (Salamanca) there was a large cork tree, the hollow trunk of which was used as a cell by some of the monks of a neighboring monastery. In 1862, in a cork plantation called *Monte Mayor*, in the province of Castellon de la Plana, cork was taken from a tree 50 feet high by 10 feet in circumference. This tree was 60 years old. In the province of Gerona the author has seen trees of a greater diameter than any mentioned above, excepting that of the valley of Batuecas, the size of which is not known.

The tree attains a great age, and its growth continues from one hundred and fifty to two hundred years. It lives after it ceases to grow, but the yield of cork is diminished.

CONDITIONS UNDER WHICH FOUND.

Geographical climate.—Extensive plantations of cork trees are found throughout the greater portion of the countries lying along the Mediterranean, as far north as the forty-fifth degree of latitude; beyond that line they do not flourish, and are sparse and of little value. Its polar line coincides with the isotherm $+13.5^{\circ}$.

Physical climate.—Cork tree requires a warm, or at least a temperate climate. It is found in Spain, at an altitude of 1,600 feet; at the same height in France, according to some authorities, and at 2,600 feet according to others. In Algeria, it grows at an elevation of 3,200 feet. The minimum average annual temperature which it can stand appears to be $+13^{\circ}$.* A southern exposure is the most favorable to its growth, although it does well in other situations when all other conditions are propitious.

The free circulation of air and an abundance of light are highly beneficial to the development of this tree, which prefers, therefore, slopes to plains, particularly if they are near the sea or immediately on the coast.

According to Antonin Bouset, the cork tree can resist differences of temperature of fifty degrees.

Soil.—Granitic lands and sandy siliceous soils are very favorable to the rapid growth of the cork tree, which seems almost to absolutely reject those which are purely calcareous. It grows spontaneously in virgin soils, where silica or silico-argillaceous compounds are abundant. It does not affect damp lands, and shuns marshes. In proof of this it will only be necessary to examine the lands occupied by the cork plantations in the provinces of Cáceres, Gerona, Castellon, and other

*The author does not say whether this temperature is according to the Reaumer or the Centigrade system. If the Reaumer is meant, it is equal to 61.25° Fahrenheit; if the Centigrade, to 55.2° Fahrenheit. It is almost safe to assume that the Centigrade is meant.

places where the calcareous soil generally drives them away, and where they abound whenever granites, Silurian slates, silico-argillaceous and sandy siliceous soils are encountered. According to Mr. H. Laure the cork tree only grows spontaneously, or in a wild state, in granitic or slaty formations. Experts in the province of Gerona affirm that the trees which yield the best cork are found on slaty lands.

FRUCTIFICATION.

The blossoms make their appearance in April or May, and the fruit ripens in the following months of September and January. Hence the different kinds of acorns, according to the time of ripening. Those which arrive at maturity in September, and sometimes about the beginning of October, are called "*Brevas*," "*Primerizas de San Miguel*" or "*Migueleñas;*" those which ripen in October and November are called "*Segunderas*" or "*Medianas de San Martin*" or "*Martineñas*"; and lastly, the acorns which do not ripen until December, or January, are known as "*Tardias*," or "*Palomeras*."

The acorns of this species of oak are more bitter, and of an inferior quality to those of the *Quercus ilex*, and are not so good as food for swine.

The trees begin to bear acorns within twelve or fifteen years, but until they reach thirty or forty the acorns are not fertile, nor is the yield abundant. It is said that the tree bears fertile seed when it yields cork sufficiently good to make bottle stoppers. Close growth or lack of light diminishes the yield of acorns, and also impairs the quality of the cork and bark, and lessens their quantity.

The acorns, although not very delicate, lose their germinative faculty even when not on the trees, if exposed to a great degree of cold.

Some varieties or sub-varieties of the cork oak produce very sweet acorns, as sweet or even sweeter than those of the *Quercus ilex*. It has also been observed that the trees which yield small oblong or round and bitter acorns produce coarse cork, and those which bear large and sweet acorns produce a finer article, and their trunks are of a more regular shape. These characteristics are, however, not generally to be relied on as indicative of the peculiarities mentioned.

PLANTING.

Having selected the seed, the first thing to be considered is the preparation of the soil to receive it. In woodlands it is not expedient, as a general thing, to dig deep, as in field labor where it is advantageous. The reason for this is very apparent. The roots of young trees penetrate very little during the first year; during that period, therefore, and often during the year following, they do not reach the bottom of the tilled soil. By tillage the earth is lossened, but it dries easily, and if the summer is at all dry and hot it loses nearly all its moisture. The roots of the seedlings in such cases find the lower portion of the soil dry, and frequently impacted, conditions highly unfavorable to their proper development. Other disadvantages result from a deep tillage of the soil. Weeds and shrubs come up and grow so rapidly as to smother the young trees. Besides this, the roots and organic ramains placed on the surface rot much more rapidly than when turned under, contributing greatly to the rapid growth of the young plants during the first years. But latter on, generally after the lapse of eight or ten years, the want of the manure which a more tardy decomposition would have supplied

makes itself felt, and the young trees become weak and puny. It should also be remembered that decomposed organic matter, under the influences of heat, light, and the atmosphere, give out, among other things, ammoniacal matters and carbonic acid, which are lost in great part if they do not come into contact with a vehicle or substance which will retain them. Covered by the soil they find this vehicle.

The cork tree needs some shelter during the first few years of its growth. If this is too great, the tree droops and finally dies. Hence the different results obtained from any one or the other of the various methods of preparing the lands for planting. To plant by sowing broadcast after the land has been plowed has the disadvantage of encouraging the growth of shrubs and weeds, and their development being more rapid than that of the cork trees, the latter are seriously injured. The mode of planting by making small excavations here and there and putting an acorn into each is open to the same objection. From motives of economy, as will be shown later, and also to protect the young trees from the ill-effects of the growth of weeds and shrubs, the "furrow" or "belt" system of planting has been adopted. This consists in planting the cork trees in rows, with one or more rows of grape-vines between. The rows of vines are from five to seven feet apart, and the acorns are planted in a furrow drawn between. The acorns and vines are planted at the same time. The former may be placed from 20 to 40 inches apart. When the young trees are sufficiently grown they may be thinned out until a sufficient number is left.

In a cork plantation of this kind near Palafrugell, province of Gerona, the cork trees, which are about twenty years old, have an average diameter of nearly 4 inches.

In 1830 Mr. Reig, in a letter addressed to the Royal and Central Agricultural Society of France, said that he planted, in 1817, one hundred and fifty ares (119.6 square yards each) with acorns of the cork tree, with alternate rows of grape-vines, with such good results that the yield of the vines more than paid for the cost of the cork plantation. He recommended that this plan should be adopted to introduce the cork tree into the thinly settled portions of the south of France. Mr. Reig left spaces of 6 feet between his trees. Their height at the date of his letter was 9 feet, with a circumference, at the base of the trunk, of 3 inches. The land on which they were grown was of the poorest description, sloping, and with only 6 inches of soil.

Up to twenty or twenty-five years the ground should be cultivated as if it was a vineyard only, taking care not to injure the young trees. In this way the weeds and shrubs will be kept under. At the end of this time the cork trees will be sufficiently grown not to need shelter, which, indeed, the vines will no longer be able to afford. On the contrary, they will become the victims of the excess of shade given by the cork trees, and will have to give way to them.

It is usual to cultivate these mixed plantations twice a year, once in January, and again in the spring. The earth should be stirred with a hoe, and the weeds and brush rooted up and burned if they are hurtful and do not readily rot, or buried with their roots if their decomposition will furnish good manure.

Under certain circumstances other methods might be advantageously followed in the preparation of the soil and the disposition of the young trees. In this paper the author proposes to lay down general principles and precepts rather than precise details and instructions, which, in his opinion, would be impossible in view of the complex nature of the conditions under consideration. It cannot be absolutely stated that any

one plant will grow and flourish in an argillaceous soil, for example, with preference for a calcareous formation, nor that it prefers one exposure to another, nor that it requires an exact amount of moisture, nor a certain fixed temperature. All and each of these conditions, and various others, may exert a modifying influence, in a greater or less degree, on each of the others. All must be considered, as all exert great influence in the development of the plant.

If there should already be any growth of shrubs or young trees on the land which might serve as a protection or shelter, planting in belts might be advantageously resorted to. The soil should only be moved in the belts in which the acorns are planted, making them from 32 to 40 inches in width. The brush removed from these belts should be thrown on the intervening uncultivated belts, thus forming an additional protection from heat and cold.

Planting in trenches may be tried when the land or the requirements of the tree are not known. It consists in marking out belts about 13½ feet wide, horizontally if on a slope, and from east to west if the ground is level. An excavation 10 feet wide and from 2 to 4 inches in depth, according to the quality of the soil, is then made, and the excavated earth thrown on the remaining portion of the belt in the shape of an embankment. Where the land slopes this embankment should be on the lower side, and on levels on the south side. In the center of the open belt a second excavation, 8 inches in depth and 4 in width, in the shape of a half cylinder, should be made longitudinally; the earth from this last excavation placed so as to form a convex surface between the first embankment and the excavation. In the remaining portion the surface of the soil may be slightly stirred. In this way all the conditions that are favorable or not to the development of the tree can be found, and an opportunity is afforded to determine the best mode of culture.

The preparation of the ground by ditching is recommended when the surface and subsoils are very much impacted, are of bad quality, or are full of thick roots. To do this, ditches from 8 to 20 inches in width and about the same depth are opened from 15 to 40 feet apart. They should be dug in summer or autumn, in order that the soil may be exposed to the action of the air for half a year at least. When it is time to plant, the earth should be thrown back into the ditches and the operation is complete. If the earth should be too compact a little sand should be added, or else a few dry sticks or weeds, which would also serve as manure. If the soil should be damp a little earth taken from the intervening spaces might be thrown on, making a sort of a ridge over the ditch. If, on the other hand, the soil should be very dry, and the situation very much exposed to heat or cold, the ditches should be filled in only up to about 4 inches from the surface. On slopes the ditches should be run horizontally, as the moisture and strength of the soil are better preserved.

Planting in squares, which is done by cutting out squares measuring 4 feet each way, in the existing growth of shrubs and young trees, and planting a few acorns in the center of each square, is superior to the belt method in affording protection to the young trees, because the earth thrown against the sides forms a sort of wall which protects them from the wind. It would not do, however, to follow this plan with close soils, for the water would accumulate in the center and injure the young plants or seed.

Planting in holes is much like the method first spoken of, so much so that a more particular description is not deemed necessary.

The acorns should be gathered when perfectly ripe. Those which

arrive at maturity in the latter part of November and the first part of December are considered the best.

The most favorable season for the germination and development of the plant is that in which the acorns fall naturally, in autumn or at the beginning of winter. But at this season the field-mice and birds are apt to eat the acorns. In the spring the young trees are exposed to injury from the late frosts, but there is less danger from this source than there is of the seeds being eaten if planted in the fall. It is impossible, however, to give any fixed rule on this point, as so much depends upon local circumstances. When there is no strong reason for planting in the spring, autumn should be preferred, because if the seed has had time to sprout the young roots spread and get a good hold during the winter, and in the spring the young plants flourish all the better.

Several methods of preserving the acorns have been adopted. One way is to put them in a sack of coarse material or in a box or barrel full of small holes, and to keep them under water until ready for planting. Another is to place them, with alternate layers of sand or earth, in trenches lined with boards or brickwork. Some persons have obtained excellent results by storing the freshly gathered acorns in a well-ventilated room, stirring them frequently, and, when tolerably dry, putting them in heaps of from 2 to 3 feet high and covering them with a coat of leaves 1 foot thick, with a further covering of branches and moss, the whole covered with a thatch of straw. It has been recommended, if a safe and sheltered place under trees can be found, that the acorns be mixed with leaves and put in heaps from 1 to 2 feet high, the whole to be covered with leaves. When the acorns are stored in this way, planting should be begun with the first approach of spring, else the acorns might sprout in the heaps.

To protect the young plants from the cold, extreme heat, and excess of light, it is sometimes the custom to mix other kinds of seed with the acorns, sometimes cereals and sometimes pine-seed, as in Gascony, where the sea-pine (*Pinus maritima*, Lam.) grows luxuriantly by the side of the cork tree. About the twelfth year some of the pines may be cut down to give more light to the soil. Two or three years later the pruning of the cork trees may be begun. Every year, until pruning is begun, all injurious shrubs should be destroyed, but care should be taken to provide sufficient shade to keep the soil from drying too rapidly. The pruning should be repeated every four or five years, and the ground around the shade-trees should be lightly worked.

In damp or marshy places, or where the land is used for pasture, transplanting or setting out young trees may be resorted to. To obtain these, acorns may be planted in beds or in pots, one acorn in each pot. The latter is more convenient, but more expensive.

In transplanting, great care should be taken to equalize, as far as possible, the absorbent surface of the roots with the exhalant surface of the leaves, preferring the spring or summer for the operation. Some plantations have been successfully planted with trees from ten to twelve years old, the tops being cut off 6 or 7 feet from the ground. If any of the roots should be broken in taking up the young tree, they should be cut off, as the bruised roots might rot and injure the tree. If the young trees can be taken up without hurting any of the roots, they may be transplanted at any time, and there will be no need to cut off any of the branches. The trees should be transplanted so soon as possible after being taken from the ground, and the roots should be covered with moss or straw if they are to be carried to a distance.

In poor land the holes in which the trees are to be placed should be dug at least six months beforehand in order to permit the soil to become mellow. In good land there is no need to dig the holes until ready to plant the trees. The holes should be large enough to admit the roots without touching the sides. A slight hollow, which should be filled with water after planting, should be left around each tree.

The trees ought to be at such a distance apart as to insure a full supply of air and an abundance of light; but not so much as to favor the growth of shrubs prejudicial to the trees, or to permit the ground to dry too much. Practical experience, an acquaintance with the locality, and a knowledge of vegetable physiology are the surest guides to depend upon to obtain the best results. As a general rule the number of trees per hectare (2.471 acres) should be from 150 to 250.

Old trees should be cut down to make room for young ones. Duhamel and other authorities have fixed the age at which cork trees should be felled at 150 years. This rule should not be applied in the province of Gerona, however, as the trees there are often valuable and yield a good product for forty or fifty years after reaching the age stated.

GATHERING THE CORK CROP.

The operation of taking off the cork, although it inflicts a real disease upon the tree, facilitates, nevertheless, the development of the trunk and the production of the coats of cork. The cork should be taken off when the sap is running. Mr. Lambert is in favor of having this work performed in the spring, because at that time, in addition to the fact that the cork is removed with greater ease than in the depth of summer, the new formation of the cork which is not yet matured, and which is useless for manufacturing purposes, is not removed. The inner bark also is not so liable to dry up and separate from the tree. Some cork growers, however, prefer to take off the cork during the months of July and August, when the sap is descending. Along the coast in the province of Gerona, this work is generally done about the last of June to the first of July, the operation being begun when the cork readily separates from the tree.

The greatest risk in taking off the cork in the spring is, perhaps, in the danger of tearing away part of the inner bark, in addition to the further danger incurred from late frosts which might kill the tree. It should be so arranged, therefore, if possible, that the newly stripped cork trees, which are then covered with an abundant exudation of sap, should not be exposed to sudden changes of temperature, particularly to the cold winds which follow the autumn rains.

The trees should be stripped for the first time when the outer covering can be taken off without injuring them. In the province of Gerona this is done when the trees are from 2 to 4 inches in diameter. This rule is not strictly adhered to, however, and it is not rare to see even smaller trees denuded of their covering. The first and sometimes the second coats of cork are of no value to make stoppers.

After the trees arrive at maturity, that is to say, when they begin to yield cork of mercantile value, it is of great importance to determine the proper period that should be allowed to elapse between the harvests. In the province of Gerona the majority of the growers strip their trees every ten years, while some do so every twelve years. Cases are mentioned where the cork was permitted to grow for eighteen years, and then gave a handsome return to the grower. As cork sufficiently thick to make champagne-stoppers is worth more than any other, grow-

ers endeavor to produce this quality sometimes by putting off the time of gathering for one or two years.

The time necessary for the production of good cork varies according to the conditions of the soil and climate, and experience is the best guide in determining when it should be gathered. When mature and fit for removal, the body of the cork is of a rose-white, which color rapidly disappears upon exposure to the air.

To remove the cork from the tree, an ax, the helve of which is wedge-shaped at the end, is used. Two circular cuts are made, one at the foot of the trunk and one at the proper height above. A longitudinal cut is then made, and after its edges are gently beaten with the ax, the end of the helve is introduced and the whole piece is easily taken off. Sometimes several circular incisions are made, and the cork is taken off in sections. After the cork is removed, two longitudinal incisions, which penetrate to the inner bark, are made in the trunk along its whole length. This is done to prevent the new formation of cork from cracking on its outer surface. Some persons make as many as four of these incisions in the trunks of the trees. They should not, however, be made on the north side. The inner part of the cork consists of a yellow substance which is useless in the manufacture of stoppers. It is composed of dried sap, or at least of a corky substance in process of formation, and is distributed equally over the surface of the trunk. This substance dries quickly, and serves as a protection to the mother, or inner, bark. This corky substance is precisely that which is taken off and lost when the cork is removed later in the season, when the sap is descending.

If all the cork is taken from the tree at once, the new cork is produced more slowly; but it is of a better quality than when the tree is only partially stripped. As it has been considered dangerous to a certain extent to deprive the trees of their whole covering at once, it has been proposed that the operation should be performed at different times; the first year taking off the cork up to a height of about 12 inches, the fourth or fifth year up to the branches, and the seventh or eighth year from the branches themselves. By this method the trees may not suffer so much from atmospheric influences. On the other hand, however, it has the inconvenience of always leaving a portion of the delicate surface of the trunk exposed to the vicissitudes of the weather. In the plantation of *Monte Mayor*, in the province of Castellon de la Plana, it is, or at least was, the custom to take the cork from half the trunk the first year; two years later it is taken off as far up as the branches; and two years after from the branches themselves.

It is not expedient to remove the first cork all at once, but at intervals of two or three years. In this way the trunk acquires a greater diameter, and the tree is not so liable to be injured by the cold.

The trunk should be stripped to the ground, because if a belt of cork should be left it would serve as a cover for ants, which would fill it with holes, or for other insects, which would cause the same, or greater damage.

If the trunk is stripped every eight or nine years the thick branches should be stripped every ten or twelve years, and the lesser ones every sixteen or twenty.

Great care should be taken not to wound or strip off any part of the mother or inner bark, because no cork is produced upon the place so injured until it is completely healed over. According to some authorities, the wound once closed, cork of a better quality than before is produced. If the injury is repeated it heals with great difficulty, and the tree is often seriously damaged.

In the province of Gerona it is very generally the practice to take the cork from the trunk only, as it is thought by this means that a better quality of cork is obtained the next time.

When the cork is all removed from the trees it is taken from the temporary places of deposit and piled up to dry slowly, and in two months loses one-fifth of its weight. Here it is inspected by the manufacturers, who buy it on the ground.

If cork trees are not stripped, the cork splits and becomes full of holes, and is worthless for making stoppers. In about fifty or sixty years the surface, exposed to atmospheric influences, begins to decompose slowly, and the cork falls off in small pieces, in the same way as the bark of other trees. It never falls off in large slabs, nor does it naturally come off while the tree is alive, as some persons have supposed, presenting the cork tree as an exceptional instance of physiological action, brought on by natural agencies on the bark of this species only.

When it is intended to improve a cork plantation which has never been stripped, the stripping should be done at once in order to obtain, eight or ten years later, an article that can be used in making stoppers. The first stripping is useless for this purpose.

A year after the first stripping the land should be cleared. In some places this is done by means of fire. General fire-lines are opened and the undergrowth within a radius of 4 to 20 feet, according to the size of the tree, is cut down. This being done, fire is applied on the windward side of the undergrowth. The operation should be performed in February or March after light rains, but never in hot, dry weather. The burning should be repeated for two or three years after each stripping.

Cutting down the undergrowth has the disadvantage of leaving the roots in the ground, which put out shoots afterwards with greater vigor than ever. The best plan, therefore, if it were not so costly, would be to pull up the shrubs by the roots.

It is claimed that by removing the stumps of the old cork trees great benefit is done to the land. It is doubtful whether this theory is correct, as the roots as they decompose may yield a good manure. In loose soils and on steep inclines stumps are never dug up, because deep washes are liable to be formed.

The men employed in stripping the cork from the trees are paid from 60 to 70 cents (12 to 14 reals) per day.

VALUE OF THE CROP.

In Extremadura cork is worth from $1.40 to $2 (7 to 10 pesetas) per 100 pounds. In Catalonia a higher price is paid. It is sold there in slabs at so much per dozen. These slabs are about 8 palms* square, and bring from $2.40 to $4 (12 to 20 pesetas) per dozen.

To-day cork is worth eleven times more than it was in 1790.

VALUE AND YIELD OF CORK PLANTATIONS.

In 1843 in the department of Var, France, cork plantations were estimated to be worth 500 francs per hectare (2.471 acres). The net return per hectare each ten years was 600 francs, or 12 per cent. per annum. At the same date oak forests only yielded 3 per cent. per annum.

To-day the value of cork plantations varies considerably, according to

*Dominguez in his dictionary gives two definitions of "palmo," the word used by the author. They correspond with the English words "span" and "hand." The latter is probably meant.

locality, the age of the trees, density of growth, and the quality of the cork produced. But as the demand for stoppers increases every day the cork plantations acquire an additional value. Large sums are invested in this kind of property, and several Catalonian stock companies have rented large plantations in Extremadura, Andalusia, and other places, and are making handsome profits out of them. In a plantation in Extremadura the first stripping was let for $200; the second brought $5,000; and the third $10,000.

MINOR PRODUCTS.

The mother bark of the cork tree contains a large amount of tannin, as much as the best oak bark. It is extensively used by the tanners of Cadiz. Cork trees grown for tan-bark are usually stripped every thirty years, at which age they are entirely denuded of their inner bark and cork. This kills the trees, and they are then cut down to the roots, from which spring new shoots, which in their turn are subjected to the same process. The roots soon lose the power of sending up vigorous shoots and get worse and worse, until at eighty years very few stumps show any signs of life. Few cork plantations are cultivated for tan-bark, as they give a better return when preserved for their yield of cork.

The wood of the cork tree is of a reddish brown. Its density, when dry, varies according to different authorities, from 0.787 to 1.560. Exposed to changes from wet to dry, it soon warps. It is very tough, and for that reason may be used in carriage and wagon making, and for similar purposes. As the wood is heavy and warps easily, and the trunks are very short, it is hardly ever used in domestic architecture. In naval construction curved pieces, which are continually under water and fastened with copper bolts, are very durable. Iron bolts cannot be used on account of the tannin contained in the wood. It also makes good piles. It burns well, but as fuel it is not so good as other species of oak. The charcoal is very good, the wood yielding about 18 per cent. of that article.

CULTIVATION OF THE NETTLE IN GERMANY.

This department is indebted to the courtesy of the Secretary of State for the subjoined correspondence and translations relative to the cultivation of the nettle in Germany:

UNITED STATES CONSULATE,
Barmen, Germany, October 10, 1878.

Hon. ASSISTANT SECRETARY OF STATE,
Washington, D. C:

SIR: An article in the Illustrate Zeitung of September 28, and a pamphlet by Frau von Roeszler Ladé on the subject of nettle-culture, have attracted some attention in this country, and thinking the subject might be of interest in our country, I have the honor to send you herewith a translation of the article in the Illustrate Zeitung, the pamphlet of Frau von Roeszler Ladé, and an abridged translation of the same.

In agricultural circles the matter has excited a great deal of interest, and the culture of nettles has begun in the neighborhood of Leipzig.

It struck me on reading the article and pamphlet that the culture of a plant so highly endowed by nature would be peculiarly adapted to the soil of some of our rocky and less favored regions, such as abound in the New England States, and in that hope I bring the subject before you.

It is possible that the culture of the nettle has already been tried in the United States, in which case, whether the experiment has been successful or not, a perusal of Frau von Roeszler's pamphlet is certain to encourage or incite to new attempts.

The pamphlet gives the result of the author's experience, and her success has been far beyond her expectations, and one is compelled to say with her that it is incomprehensible that a plant possessing such a great variety of merits should, for ages, have been regarded merely as a noxious and troublesome weed.

I am, sir, your obedient servant,

EDGAR STANTON,
United States Consul.

[From Illustrate Zeitung, September 28, 1878.]

THE NETTLE AND ITS FUTURE.

The consideration of the question whether the nettle, heretofore regarded as a noxious weed, shall be included in the list of useful commercial plants, has recently engrossed the attention of German agricultural circles in the liveliest manner. No new discovery is here referred to, but a new trial solely of the practicability of utilizing a fibrous plant whose excellent qualities have lain in seclusion long enough.

The nettle was known as a fibrous plant more than a thousand years ago. It is still esteemed as cattle-fodder and is employed remedially for many ailments of both man and beast.

In spite of this diversity of uses the nettle has always been treated as one of the most troublesome of weeds. In the last century the introduction of cotton caused it to be forgotten and entirely ignored by the industry it has every right to serve.

Only when the German agriculturist was forced to seek some new plant to cultivate was the weed by the wayside, the despised nettle, remembered and brought to light once more that its many excellent qualities might be made use of.

Inspector Bouché, Dr. Grothe, Professor Reuleur, and others have called attention to the nettle. Dr. Holzach, of Entritzsch, deserves also great credit for his defense of the nettle in agricultural circles, which has caused the nettle-culture to be taken up in the Leipzig district, but to Frau von Roeszler Ladé belongs the unqualified merit of having restored the falsely judged plant to the estimation of the public.

The success in experimental nettle-culture, which has exceeded all expectations, causes every one to feel more or less interested in the matter, and there are already many sanguine natures who believe that nettle-culture will render the import of cotton superfluous.

If the nettle were able to reduce the import of foreign fibrous plants it would be the attainment of decided progress in a direction we are all energetically working to reach.

The statistics of hemp culture, for which the nettle is a perfect substitute, exhibit how much greater is the import into than the export from Germany, the excess value being in—

	Marks.
1873	10,833,000
1874	13,731,000
1875	13,860,000
1876	8,050,000
In four years	46,474,000

The value of flax imported is in still greater excess, viz:

	Marks.
1873	23,040,000
1874	22,072,000
1875	16,515,000
1876	9,400,000
In four years	71,027,000

Of the 200 species known to botanists but one, the *Urtica dioica*, belongs to the German flora. This plant, which in a wild state grows to a height of two meters, is divided into two varieties, the red and green stemmed, the latter being supposed to yield the finest fibers. It thrives in every soil, but the better the soil the more luxuriant the growth.

The yield for ten or fifteen years is almost invariably the same. Shade is preferred to sunshine, and, excepting the first year or two, but little or no care is necessary. It is harvested in August. The leaves are stripped off and serve as fodder, while the stems are treated in the same manner as flax.

While but little susceptible to the influences of the weather, the nettle has a number of vegetable and insect enemies which hinder its development. No less than nine species of beetles and forty sorts of caterpillars are known to take up their destructive abode in the nettle, which suffers also from the vegetable parasite *Cuscuta europæa.*

The cultivation of the nettle as yet has been too limited to permit of definite estimates of the yield, but it is certain, from experiments actually made, that it is a grateful plant, and likely to exceed grain in the abundance of the yield. Before large tracts are, however, given over to nettle culture, it would be advisable to make more extensive experiments in sterile districts, wood openings, escarpments and railway dams, &c. The latter are especially adapted for the culture, since the nettle requires little or no care, and yields a more abundant and better fodder than any other which would grow on the *steppes.*

EXPERIMENTS OF FRAU VON ROESZLER LADÉ.

Frau von Ladé, in a small pamphlet just published, entitled "Die Nessel eine Gespirmstpflanze," writes of the nettle as follows:

"Nettles (*urtica*), of which there are sixty-nine species, are found in Europe, Asia, and America. The best and finest species are the Indian and Chinese nettles, the *Urtica Nivea.* This species, however, like the tea-rose, only thrives in this (German) climate when planted in warm districts and is well protected from the cold. Its fibers are wonderfully white and glossy, and the plant is highly esteemed in China. Its fibers are known in England under the name of China grass.

"Besides this species there are the *Urtica canabina*, a native of Siberia, and the *U. Laportea canadensis*, a Canadian plant, which are hardy species with fine fibers and well adapted to this climate.

"The German nettle (*Urtica dioica*) is known in Europe, Asia, and America as one of the most frequent and difficult of weeds to exterminate. In Europe there are two sorts, the red and green stemmed, the latter yielding the best fibers. Both are good sized plants, reaching, according to the soil, to a height of six or seven feet.

"The nettle thrives in every soil, being found on the heath, sand, and moors, in the hedges and ditches, on dung-hills, garbage, &c. In planting nettles, therefore, no great care is necessary in the choice of the soil, but a good digging or plowing, with plenty of manure, are great developers. After such treatment the land should be left until spring and harrowed immediately before planting.

"The roots of the nettle form in the course of time a flat, felt-like covering, whence rocky and unfertile districts, if covered with a couple of inches of soil, may be advantageously turned into nettle plantations, the network of roots effectively protecting the soil from the washing of rain and storms. Though the nettles grown on such soil do not yield the finest fibers, they furnish good cattle-fodder if planted with *Urtica dioica*. Krürichz obtained 18 wagon-loads from an acre so planted.

"Since the plants stand from 10 to 15 years, the land ought to be well dug or plowed and manured before planting. It is not known which is the best fertilizer, but in the absence of animal manure alder leaves spread three or four inches deep after the nettle has been harvested is very good; and instead of alder leaves the foliage of pines, junipers, &c., or straw may be used, but when using these dressings, animal or alder manure must be spread on the third year.

"From animals the nettle has nothing to fear, and its greatest enemy is the *Cuscuta europæa*, a parasitical plant, which grows so rapidly as to smother the nettle in 24 hours. The simplest method of destroying this parasite is by spreading salt, which is at the same time beneficial to the nettle.

"The best time for planting the roots is in the spring after plowing and manuring as above mentioned, by slips or shoots, so that they may have struck root before winter. To raise from seed is unprofitable, since they are only fit for transplanting in the second year.

"In planting, the roots are set out in bunches of three in rows 35 centimeters apart, the intervals between the plants being about 30 centimeters. Bouché put the roots from 1 to 3 meters apart, and recommends planting other plants, such as willows, hazel, &c., in the broad intervals which, while shading the nettles, are useful in other ways. The rows should run from north to south to shelter the plants as much as possible from the heat of the sun. The willows best adapted for this purpose are the salix, caspica, daphnoides, and calodendrons. It is, however, unnecessary to set out shade plants unless the nettles are planted in a very sunny exposure. It is possible that the planting of nettles in fruit trees would be killing "two birds with one stone," inasmuch as the fruit trees would furnish the nettles shade while the latter would protect the fruit from unlawful plunderers.

"As to the best time for cutting the nettle opinion varies. In the previous century the nettle was cut just after flowering and when the stem had just begun to wither. Bouché recommends cutting before the seeds ripen, because the fibers are then supple and tenderer; and, following this advice the crop should be cut in the first half of August.

The nettle should be cut with a sickle in the early morning while the dew is still on it, for the prickles are then moist and pliable and do not sting. The plants should be cut, not pulled, close to the roots, and the stems should lie forty-eight hours after cutting. The dried nettles, having lost their stinging power, are stripped of their leaves, which may be gathered for fodder or left as manure. The nettle bundles must not be piled on each other, as they are liable to heat after twenty-four hours, and so injure the fiber.

"As fodder, the nettle, during the first two or three years, may be

harvested two or three times, later four or five times, or as often as the plants are 1 or 2 feet high and remain tender.

"The nettle may be mixed with the cattle fodder or infused and served warm the next day, in which shape cattle are generally fond of it. This infusion has a brown color, and, for animals, a pleasant odor. Cows and goats yield more milk, the milk more and better colored butter even in winter; swine fatten quicker and better when fed with this fodder. A handful of nettle seeds mixed daily with their oats makes horses plump and gives them glossy coats. The harvested nettle should be treated like flax. Krürichz says:

> When nettles are gathered they should be spread out on the meadows a couple of days to dry, that the leaves may be easily stripped from their stems, then bound in bunches; like hemp, they should, according to the weather, be left from six to seven days in a clear pond or rain water to rust. After this so-called rusting they must be well dried and stored in a dry place for hackling. Being liable to heat after twenty-four hours, the nettle must be very carefully dried. The future treatment is the same as for hemp."

Frau von Roeszler Ladé has pursued a little different course, and left the nettle stem about fourteen days to dry, then rusted and hackled like hemp, and has found this treatment satisfactory. It may, however, be better to let the nettle stems lie in flowing water some days, since the straw-like parts are then more easily separated from the fiber.

In hackling the utmost care must be taken, for the nettle fibers are exceedingly tender, and must not be beaten too much.

The treatment is generally like that of hemp, and it is singular that in rusting both the nettle and the flax have the same appearance and odor.

While hemp is first boiled as yarn, I have boiled the nettle before hackling, and found that the fibers were cleaner and more tender, and consequently more easy to spin.

According to Gothe, nettle fibers are prepared as follows in England: The fibers are first laid in a lye of hot water, with soap and some oil, when, after they are passed through a wringing-machine, they are boiled seven or eight hours in clean water. The washing process may be frequently repeated, the result being a complete cleansing of the fiber, a delicate separation of the same, the removal of all knots and vegetable gums, and consequently an increased softness of the fiber.

The hackling was done with a common hand-hackle, and on the invention of a hackling-machine suitable for nettles the results are certain to be more satisfactory. Whether it is better to raise nettles than hemp is a question at present difficult to answer. Hemp requires more care both in planting and harvesting than the nettle. Hemp needs a very good soil; while nettles flourish where no other plants will grow. Heavy storms are very injurious to a hemp field, while nettles have nothing to fear from hail, storm, or rain.

Nettles thrive in the poorest soil and under all circumstances, while the hemp crop is by no means a good one every year.

Once planted nettles stand from ten to fifteen years, and, beyond harvesting, require little or no care, while hemp must be resown each year.

The yarn of the nettle is at least just as good as that of hemp, and I think now capable of improvement. Nettle yarn which I have spun is stronger, softer, and more glossy than that of hemp, although prepared with a common hackle, and I am convinced that after some generations of culture, and with proper mechanical treatment, the nettle will yield a much finer and more beautiful fiber than hemp.

As far as the yield is concerned, I have gained 3 pounds of yarn from one rod planted in nettles, and from the 3 pounds of yarn 4 ells of cloth;

an acre consequently would yield on the average 300 pounds of yarn, or 400 ells of cloth, which is certainly a good result.

As every plant when cultivated yields more than when in a wild state, so can a greater yield be in the course of time expected from nettles.

Until better machinery is invented for hackling, the nettle yarn is more adapted to articles of home consumption, such as bed and table linen, sacks, ropes, sails, &c. The nettle is easily bleached and dyes well, so that it possesses all the qualities which can be desired.

Nature has endowed the nettle thus that it might play an important role in our domestic economy, and it is certain to stand with honor every trial to which it can be put.

TOBACCO.

Tobacco, paying to the general government, as it has done, a revenue of more than 426 millions of dollars in sixteen years, justly occupies a prominent place among the agricultural productions of the country.

Naturally, we might expect to find the condition of those engaged in its cultivation both hopeful and prosperous. As a matter of fact, there is no other crop more languishing, or one from which the producer has, for the past two or three years, and for even a longer period, derived so little profit.

Our tables show that the annual revenue to the government from manufactured tobacco of all kinds has for several years been greater than the receipts of the planters from the respective crops of those years; the excess in the case of the crop of 1877 reaching the large sum of about twelve and a half millions of dollars.

In view of a contrast so marked, we are at once and irresistibly led to inquire into its causes, and to consider whether a remedy may not be found. To the tobacco grower himself who looks to this crop (as in many sections of the country he is forced to do), as his chief if not only "money crop," the solution of this problem is one of overshadowing importance.

The history of the plant; its histology; the derivation of its name; whether Nicot, Sir Walter Raleigh or some other person, was the first to bring it to the attention of the civilized world; what are its elementary constituents; what its chemical and medicinal properties; these and all kindred questions pale into insignificance beside the one pertinent, practical inquiry, "How may the production of tobacco be made remunerative to the producer in this country?"

Turning aside, then, from the early history of this plant, now become but little more a luxury than a necessity of life; leaving it to others to trace its gradual but steady progress from a limited use, in a crude condition, by savage tribes, to its present universal adoption in the various attractive forms in which it is to-day offered in every land and clime, it will be our endeavor in the present article, to show the causes which, in our belief, have led to existing low prices, and to point out the way by which to escape the like damaging result in the future.

I.—THE CAUSES OF THE PRESENT DEPRESSION OF PRICES.

Much of this is to be ascribed, without doubt, to that general stagnation in all kinds of business which has made the five years just passed memorable for all time in the annals of trade. It was not to be expected that

in the general shrinkage of all values, in the widespread financial distress which for five weary years has covered, as with a pall, the entire country, amid "the wreck of matter and the crush of"—fortunes, tobacco alone should prove an exception to an inflexible rule. Something, too, of the low price is, unquestionably, due to the agitation of the greatly vexed tax question—to its agitation rather than to the tax itself; and in proof of this last assertion we would point to the fact that in 1867, when the tax amounted to about 33 cents per pound against 24 cents in 1878, the average price of tobacco, on the farm, was somewhat more than 13 cents per pound against the present rate, a little more than 5½ cents. Now, at the former date, there was no agitation and no thought of agitation relative to the tax. The higher tax was quietly acquiesced in; the government had no unusual trouble in collecting it; and the planter himself was contented and prosperous in the handsome price he received.

We must, then, look behind this question of tax if we would find the true cause of existing trouble. And, so looking, what is the most striking fact observed; what the most obvious conclusion to which we must come? The *fact* that in 1869 the crop of the United States amounted to but about 324,000,000 pounds against, in round numbers, 412,000,000 in 1870; 410,000,000 in 1871; 505,000,000 in 1872; 502,000,000 in 1873; 358,000,000 in 1874; 520,000,000 in 1875; 482,000,000 in 1876; and 581,500,000 in 1877*—the *conclusion* that year by year, with slight variation, the planters have gone on increasing the crop until they have glutted the markets of the world.

Being, to many, as we have observed, the only "money" crop, there was a strong temptation to the gradual overproduction, which culminated in the enormous crop of 1877, and has carried the price down, year by year, until it has fallen to-day below the probable cost of production.

We say, then, and are confident in the assertion, that overproduction (which means in this case, as we shall presently show, the production of *poor* tobacco) is the controlling cause of the unhappy condition in which the tobacco-planters of the United States now find themselves.

Bad under any combination of circumstances, overproduction is made incomparably worse when the article produced is of inferior quality. Inferiority, it is universally admitted, has marked the character of our tobaccos for several years. A good article of any description of tobacco

*It will be seen that the "product" of the country here given for the years 1869 and 1877 inclusive, differs materially from that hitherto published in the reports of this department.

These discrepancies, arising, no doubt, from inaccurate data in making previous estimates, are much to be regretted; but the department would be doing the nation and itself injustice to perpetuate error in order that its reports should be consistent with each other rather than with the facts.

Of the material correctness of the above statement, made up chiefly from data furnished in the reports of the Bureau of Internal Revenue and of the Bureau of Statistics of the Treasury Department, we are fully satisfied. It is evident that the amount of leaf tobacco exported and the amount of leaf represented in manufactured tobacco of all kinds annually, when added together, will represent the annual crop produced, less the percentage consumed on the farm and otherwise evading the tax; and that, whilst this sum, from the "lapping over" of a part of one year's crop into another, may not show the *exact* product of any given year, yet, in a series of years, the result will be almost mathematically correct.

In special report No. 10 of the current series we stated "the total amount exported and manufactured" as being "a little more than 463,000,000 pounds." As to the *fiscal* year, this was correct. But further examination has satisfied us that we shall approximate nearer to the crop of 1877 by taking as a basis of calculation the amount exported and manufactured for the calendar year ending December 31, 1878. We have accordingly adopted this method, both for 1878 and for the preceding eight years, with the result shown.

has, in truth, not shared in the general depression of prices. It is the heavy weight of the enormous bulk of "nondescript," *i. e., worthless*, tobacco that has toppled the whole fabric.

The production of good tobacco, of whatever kind, has never been too large. It is the production of poor tobacco—of what in reality is but a base imitation—that has caused the mischief. Like every other farm product of poor quality, whether poor cotton, poor rice, poor wheat, or poor corn, poor tobacco has a long and weary way to travel in finding a purchaser. Lacking purchasers, it is self-evident that all sorts of stocks, tobacco being no exception, soon gain immense and unwieldy proportions. In Liverpool, London, Bremen, New Orleans, Baltimore, and New York, alone, the stock had accumulated, November 1, 1878, to 159,761 hogsheads against 89,606 hogsheads the same day of 1875.

If we seek further for the cause of this large increase of stocks we shall find it readily and unmistakably in the *inferiority* of a great part of the tobacco *now on hand*. It is an open secret that much of the tobacco now held in foreign markets is "funked"—vile stuff, fit for manure only. And yet, month after month, and year after year, this is heralded in trade reports, swelling stocks, and so *bearing* the tobacco markets of the world. And here we may remark, parenthetically, that in considering means of relief to the well-nigh ruined planter attention might, very properly, be directed to the development of a plan for burning this worse than worthless surplusage, as in colonial times.

But if this be the proximate cause of much of the depression of this industry, it is no less certain that the greater share of that depression is traceable to the very door of the planter himself. In his neglect—whether from overcropping or otherwise—of the crop in the field, or his equally fatal neglect or ignorance in "handling" it after being housed, may be found the "direful source of woes unnumbered," not to him only, but to the trade and to the country.

II.—THE WAY OF ESCAPE.

So manifestly does this lie in the reduction of the area of the crop and in increased attention thereto, "from the plant-bed to market," that "the wayfaring man, though a fool, cannot err therein." The planter who may chance to read these pages should not fail to note the words "reduction of area" as contradistinguished from reduction of crop. The terms are not convertible. Reduction of area does not mean reduction of crop. On the contrary, it may mean, and should mean, an increase of crop. No; we do not advocate a reduction in the production of *tobacco*, but a reduction, nay, the complete abandonment of the production of *inferior* tobacco, or what is only a pretense of tobacco. We are firm in the opinion, before expressed, that no crop of really first-class tobacco is likely ever to be too large. The appetite which loathes with increasing force that which is repulsive becomes often a passionate desire when fed on dainties. As the production of choice, high-grade tobaccos is increased, a correspondingly increased taste and desire will be developed and cultivated, and corresponding wants be multiplied and enlarged, *pari passu*, to utilize and consume them.

We need have no fear, then, of the overproduction of *good* tobacco. It is the production at all of the low grades, or more properly no grades, that is to be guarded against. And here, in the inflexible adherence to this policy and to this practice is to be found the remedy, the only sure remedy, for "the ills we bear." It were no argument against the value of this remedy to point to the fact that the crop of 1867, though poor

in quality, yet commanded an almost unprecedentedly high price. A commodity may be so scarce as to sell well despite its inferiority. Such was the case with tobacco at that time, the crop being but a little more than half the crop of 1877. But when the commodity is both poor and excessively abundant, as is tobacco now, there can be no reasonable hope of other than ruinously low values.

The remedy found, it remains only to determine the proper manner in which to apply it. The first step, without doubt, is, as the doctors say, to "reduce the swelling," *i. e.*, diminish the area. This done, the heavy applications of home-made manures indispensable (all new ideas to the contrary notwithstanding) to the production of the best tobaccos become more possible. More than ever in the reduced number of all kinds of farm stock kept and able to be kept in many large tobacco-producing States do the planters of to-day find it difficult to collect the requisite amount of stable and barn-yard manure. Less than ever are they able to purchase the commercial article. Ordinarily, therefore, whenever the planter begins to increase materially the size of his tobacco lots, that moment does he commence to dilute, so to speak, his manure-heap and to employ a method of long division in its distribution that can, by no possibility, result in anything else than thin, trashy, undesirable, and hence unsalable tobacco.

It is said by some that heavy manuring is injurious to certain kinds of cigar or seed-leaf tobacco, and perhaps to "bright wrappers" and the like. We question the accuracy of this statement, and are quite sure that, with respect to the great bulk of tobacco in the large producing States, an area which it is possible to make rich, an area reeking as it were with fertility, is the only area on which a *paying* crop of tobacco can be made. Good seasons, thorough preparation, nice cultivation, careful "worming and suckering," and intelligent, painstaking curing and after-manipulation go a long way, undoubtedly, toward the production of a good article; but they are all of little avail if the crop has been planted on poor land that has not been aided by a fertilizer of some sort; and even this would not be a complete remedy, for, to obtain the best results, land for tobacco should be friable as well as fertile, and this condition of soil, it is well known, can be attained only by gradual approach. It may be stated as an axiom that poor land, however abundantly manured, will not make first-class tobacco the first year.

The first step, then, toward recovery will have been taken by the planters of the country when they shall have circumscribed their crops within areas which have been brought to the highest state of fertility. That such has not hitherto been the prevailing condition of areas is evidenced by the small average yield per acre in nearly every large producing State. For the decade ending with 1878 that average was but about 700 pounds. This in itself is sufficient proof that the quality of the tobacco was poor. Twelve hundred pounds per acre would seem to be the minimum of profitable production; but even this amount falls far short of what should be aimed at, and what can readily be grown under average conditions of weather. Indeed it would be difficult to fix the limit to the possible production of tobacco from one acre of ground in the highest state of fertility and with but ordinarily propitious seasons. Twenty-five hundred pounds are known to have been produced—twenty-five hundred pounds, which, we are safe in asserting, could not have been bought then, and would not be sold to-day if on the market, for the insufficient sum of 5.6 cents per pound, the average price at present.

With our limited space we cannot now undertake to follow this crop "from the seed to the warehouse," by describing in detail the many and

varied operations through which it has to pass, and particularly as these relate to different varieties of tobacco.

The principal points to be attended to if the best results are to be attained may be stated in a few paragraphs—paragraphs which, while referring mainly to shipping, manufacturing, and smoking tobacco as constituting nine-tenths of the tobacco grown in the United States, embody principles and prescribe modes of management nearly identical with those to be considered in the treatment of other tobaccos.

I. Select good land for the crop; plow and subsoil it *in autumn* to get the multiplied benefits of winter's freezes. This cannot be too strongly urged.

II. Have early and vigorous plants and *plenty of them*. It were better to have 100,000 too many than 10,000 too few. They are the corner-stone of the building. To make sure of them give personal attention to the selection and preparation of the plant-bed and to the care of the young plants in the means necessary to hasten their growth, and to protect them from the dreaded fly.

III. Collect manure in season and out of season, and from every available source—from the fence-corners, the ditch-banks, the urinal, the ash-pile. Distribute it with a liberal hand; nothing short of princely liberality will answer. Plow it under (both the home-made and the commercial) in *February*, that it may become thoroughly incorporated in the soil and be ready to answer to the first and every call of the growing plant. Often (we believe generally) the greater part of manure applied to tobacco—and this is true of the "bought" fertilizer as well as of that made on the farm—is lost to that crop from being applied too late. Don't wait to apply your dearly-purchased guano in the hill or the drill from fear that, if applied sooner, it will vanish into thin air before the plant needs it. This is an exploded fallacy. Experience, our best teacher, has demonstrated beyond cavil that stable and commercial manure are most efficacious when used in conjunction. In no other way can they be so intimately intermixed as by plowing them under—the one broadcasted on the other—at an early period of the preparation of the tobacco lot. This second plowing should not be so deep as the first; an average of three to four inches is about the right depth.

IV. Early in May (in the main tobacco belt to which this article chiefly refers, that is to say, between the thirty-fifth and fortieth parallels of north latitude), replow the land to about the depth of the February plowing, and drag and cross-drag, and, if need be, drag it again, until the soil is brought to the finest possible tilth. Thus you augment many fold the probabilities of a "stand" on the first planting, and lessen materially the subsequent labor of cultivation. Plant on "lists" (narrow beds made by throwing four furrows together with the mold-board plow) rather than in hills, if for no other reason than that having now, if never before, to pay wages in some shape to labor, whenever and wherever possible horse-power should be substituted for man-power—the plow for the hoe.

V. Plant as early as possible after a continuance of pleasant spring weather is assured. Seek to have a *forward* crop, as the benefits claimed for a late one from the fall dews do not compensate for the many advantages resulting from early maturity. Make it an inflexible rule to plant no tobacco after the 10th of July—we mean, of course, in the tobacco belt we have named. Where one good crop is made from later planting ninety-nine prove utter failures. Far better *rub out and start afresh the next year*. Take pains in transplanting, that little or no replanting may be necessary. The cut-worm being a prime cause

of most of the trouble in securing a stand, hunt it assiduously and particularly in the early morning when it can most readily be found.

VI. Keep the grass and weeds down, and the soil loose and mellow by frequent stirring, avoiding as much as possible cutting and tearing the roots of the plant in all stages of its growth, and more especially after *topping*. When at all practicable—and, with the great improvement in cultivators, sweeps, and other farm implements, it is oftener practicable than generally supposed—substitute for hand-work in cultivation that of the horse. The difference in cost will tell in the balance-sheet at the close of the operation.

VII. Attend closely to "worming," for on it hinges in no little degree the quality and quantity of tobacco you will have for sale. A worm-eaten crop brings no money. So important is this operation that it may properly claim more than a passing notice. Not only is it the most tedious, the most unremitting, and the most expensive operation connected with the production of tobacco, but the necessity for it determines more than all other causes the limit of the crop which in general it has been found possible for a single hand to manage. Therefore bring to your aid every possible adjunct in diminishing the number of worms. Use poison for killing the moth in the manner so frequently described in treatises on tobacco, to-wit, by injecting a solution of cobalt or other deadly drug into the flower of the Jamestown or "jimson" weed (*Datura stramonium*), if necessary planting seeds of the weed for the purpose. Employ at night the flames of lamps, of torches, or of huge bonfires, in which the moth may find a quick and certain death.

In worming, spare those worms found covered with a white film or net-like substance, this being the cocoon producing the ichneumon-fly, an enemy to the worm likely to prove a valuable ally to the planter in his war of extermination.

Turn your flock of turkeys into the tobacco-field, that they, too, may prey upon the pest, and themselves grow fat in so doing.

If these remedies should fail, sprinkle diluted spirits of turpentine over the plant through the rose of a watering-pot, a herculean task truly in a large crop, but mere child's play to the hand-picking process, for the one sprinkling suffices to keep off the worms for all time, whereas the hand-picking is a continual round of expensive labor from the appearance of the first worm until the last plant has been carried to the barn. We have no idea that such sprinkling will at all affect the odor or flavor of the tobacco when cured.

If, as stated by a writer in a California paper, the well-known "yellow-jacket" be useful in destroying tobacco-worms, by all means win it as an ally. As proving its usefulness, the writer asserts that one of his neighbors, a Mr. Culp, during fifteen years growing tobacco, has never expended a dollar for labor to destroy the worm, trusting all to this little workman, who, he says, carefully searches the plants for the worms, and never allows one to escape its vigilance.

We cannot speak from our own experience as to many of these suggested means for overcoming the horn-worm, but we have no hesitation in saying to the farmer, try any, try all of them rather than have your crop eaten to shreds, and the labor of more than half the year brought to naught in a few days, it may be, by a single "glut" of worms.

VIII. "Prime high and top low." While open to objection in particular cases, even with the character of tobacco chiefly under consideration, and altogether inadmissible, it may be, in the management of other varieties of tobacco, this is a safe rule, we think, to follow in general practice.

We favor "priming" by all means; for when no priming is done the

lower leaves (made worthless by constant whipping on the ground) serve only as a harbor for worms, which are the more difficult to find because of the increased burden of stooping. Moreover, if the bottom leaves be saved on the cut stalk, as most likely they will be, there is always the temptation to put them on the market; and against a *sacrilege* like this we are firmly set, let others say and think what they may.

Yet another advantage to be gained by the removal of these bottom leaves, which is what the planter terms "priming," is the increased circulation of air and distribution of light thereby afforded, both essential factors, the merest tyro knows, to the full development of plant life.

"Topping" (the pinching off with the finger-nail the bud at the top of the plant) is an operation requiring considerable skill and judgment. Let it be performed only by hands having these prerequisites.

That as many plants as possible may ripen at the same time (a desideratum not to be undervalued in aiming, as all should, at a *uniform* crop) wait until a large number of plants begin to button before commencing to top. Going about through the crop, topping a plant here and there because it may chance to have buttoned before its fellows, is a damaging process not to be tolerated.

No inflexible rule can be given for the number of leaves that should be left on a plant. All depends upon the variety of tobacco, the strength of the soil, the promise of the particular plant, the probable seasons and time left for ripening, &c.

One of the most successful growers of heavy dark tobacco we have ever known once stated to us his conviction, after years of observation and practice, that one year with another, taking the seasons as they come, eight leaves would give a better result than any other number. Our own experience has tended to confirm this judgment.

IX. See to it that the suckers are promptly removed. It is work quickly done, and with worming may constitute a single operation.

X. We come now to consider the last operation in the field, "cutting" the crop. In this, as in topping, a man of judgment, experience, and fidelity is needed. An inexperienced hand, one without judgment, and particularly one who is indifferent to the interests of his employer, will slash away, right and left, not knowing or not caring whether the tobacco he cuts be ripe or green, doing more damage in a few hours than his whole year's wages would compensate for, even could they be garnisheed.

Therefore, be on hand to see for yourself, and do not delegate the duty to any less interested party, that a crop managed well, it may be, so far, from the initial plant-bed, shall not be spoiled in the closing work by an incompetent or unfaithful cutter.

Be there, too, to see, in this supreme hour, that injury from sunburn is warded off by the timely removal, to the shade, of the plants that have been cut, or by a proper covering, where they lie, against the scorching rays of the sun. The neglect of this precaution has played havoc with many a crop when brought under the auctioneer's hammer.

XI: We should have no space to describe the different methods of "curing" tobacco, as, for instance, "sun-curing," "air-curing," "flue-curing," "open-fire-curing," &c., even though the whole subject had not been gone over again and again in previous reports of this Department. We can only say of this operation, as of all others connected with the production of tobacco, that much depends on its proper doing and that, as much as possible, it should have the personal superintendence of the owner.

But the crop may have been brought along successfully even to the

completion of this operation and "lack one thing yet," if it be not now properly manipulated.

Therefore, go yourself, brother planter, into your barns, see with your own eyes, and not through the medium of others; handle with your own hands, and *know of a surety* that the tobacco hanging on the tier-poles is in proper order for "striking" and "bulking," and act accordingly.

When, later on, it is being "stripped," "sorted," and tied into bundles, or "hands," as they are often called, be there again, *propriâ personâ*, to see that it is properly classed, both as to color and to length, the "lugs" going with lugs, the "short" with short, the "long" with long, &c. Instruct those sorting that when in doubt as to where a particular leaf should be put to put it at least one grade lower than they had thought of doing. Thus any error will be on the safe side.

Prize in hogsheads to weigh what is usually called for in the market in which you sell, and, above all, "let the tobacco in each hogshead be as near alike as possible, uniform throughout, so that the 'sample,' from whatever point it may be taken, can be relied on as representing the whole hogshead," and that there be left no shadow of suspicion that "nesting" has been attempted, or any dishonest practice even so much as winked at.

We sum up the whole matter by repeating:

1. That overproduction, the production at all, of *low* grade tobacco is the chief cause of the present extremely low price of the entire commodity.

2. That the planters of the United States have the remedy in their own hands; that remedy being the reduction of area, this reduction to result, from the employment of the means here suggested, in increased crops; and, paradoxical as it may seem, these increased crops to bring greatly enhanced values.

The whole world wants good tobacco, and will pay well for it. Scarcely a people on earth seeks poor tobacco or will buy it at any price.

In a word, then, one acre must be made to yield what it has hitherto taken two or three acres to produce; and this double or treble quantity must be made (as, indeed, under good management it could not fail to be) immeasurably superior in quality to that now grown on the greater number of acres.

Either this or the abandonment of the crop altogether—one or the other.

Planters, "Choose ye, this day, whom ye will serve."

LOCALITIES BEST SUITED FOR MATURING SEED.

By Peter Henderson, *Jersey City Heights, N. J.*

Seed-growing is now getting to be one of the industries of the United States, as it has long been that of Europe. Our great variety of latitude, soil, and climate is such that in many things we are now supplying Europe with that which a few years ago we imported; and I think it is safe to predict that in a majority of the seeds of the garden the balance of trade will ultimately be in our favor, as it is now with a majority of the seeds of the farm. I say a majority, for as seed-growing is a matter of latitude, there always will be some kinds that will attain perfection better in Europe than America, particularly such seeds as require a low temperature for perfect development. Hence, whenever a

full variety of seeds is attempted to be grown in any one district either here or in Europe, some crops will be a complete failure and many partially so, for we might as well attempt to "acclimatize" the white bear of Iceland to the jungles of Africa, or the Bengal tiger to the forests of Norway, as to perfectly develop the seeds of oats in our Southern States, or the seed of maize in Northern Europe. Still, we find these attempts are made and will be made by inexperienced cultivators of seeds, resulting not only in ultimate failure to the grower, but also seriously injuring those to whom such undeveloped seeds are sold.

When seeds are grown in a latitude unsuited to their development, such seeds will invariably perpetuate weak progeny. A marked case in point is the oat, a grain requiring a low temperature for perfect development; hence the superiority of the Scotch or Irish oats over those grown in the hot and dry summers of the United States. The average weight per bushel of Scotch oats may be given as 44 pounds, while the average of oats grown in the United States is about 32 pounds per bushel; yet we find that if Scotch oats weighing 44 pounds per bushel, when sown in the Middle States under favorable conditions, deteriorates to 40 pounds per bushel the first season from the imported seed; that product again sown they will still further deteriorate to 35 or 36 pounds per bushel, which again being sown the third year falls down to the normal condition of the American oats, say 30 or 32 pounds per bushel. These facts suggest the query whether it would not pay our farmers to import their seed oats in order to get this improved quality. In my opinion there is no other way to do it, for no matter how careful the selection of seeds is made, deterioration will take place when the crop is grown under circumstances uncongenial to it. A lifetime spent in the practical study of horticulture, which is close akin to agriculture, has forced me to the conclusion that there is no such thing as acclimation of plants. The maize of the American continent resists all attempts to bring the crop to full maturity in the climate of Great Britain, while the oat (*Avena sativa*) gives comparatively abortive results when grown in our semi-tropical summers. Hundreds of instances in families of plants grown for their fruits, flowers, or seeds, could be given to show that whenever any attempt is made to change characteristics incident to their natural origin, no perceptible advance is ever made. We all know that attempts to acclimatize the fig, the olive, and the orange tree in the open air in any locality where the thermometer falls below zero, the complete destruction of the trees would be the result unless artificially protected. This result is marked and complete, and is universally known even to such as have not made these matters a special study. But every cultivator of large experience knows that the same rule runs through all grades of vegetation, and that the hardening or acclimatizing of plants has not advanced, as far as the records go. We remember when the Chinese *Wistaria* was grown only in our greenhouses; now it is seen everywhere as a hardy vine; but it was in ignorance of its hardy nature that it was ever protected, for it was equally "hardy" the day of its first introduction as it is to-day.

The garden and farm seeds in general use in the United States, I have said, are mainly grown here, though some are better grown in other countries. I will briefly state the localities so far found to be best suited to the greatest development of the different kinds, and the sources from which seedsmen draw their supplies. I am indebted for much information on this subject to Mr. William Meggat, seed-grower of Hartford, Conn., who has given this subject special study for the past twenty years.

Asparagus—Is grown in New Jersey, Long Island and other portions of New York, and probably other parts of the Northern and Middle States.

Beets—Central New York, Pennsylvania, and Connecticut. Mangel and sugar beets are as yet mostly imported.

Beans (Bush)—Mostly grown in New York State, though Michigan, Wisconsin, and Pennsylvania are beginning to grow considerable quantities.

Beans (Pole)—Connecticut, New Jersey, Pennsylvania, Maryland, and Delaware, and States further south.

Cabbage—One of our most important crops, gives best development near the sea-coast. That grown on rich soils inland is never so satisfactory. Hence our market gardeners and farmers in the vicinity of New York, from experience dearly bought, prefer their cabbage seed for early crop to be always grown on the easterly side of Long Island on the Atlantic coast to that from any other source. There is considerable grown in Pennsylvania, New Jersey, Connecticut, and Rhode Island, but such has never come to be held in any favor by our market gardeners in the vicinity of New York, who, perhaps, are as critical in such matters as anywhere in the world. But little cabbage seed is now imported, though it is sold much cheaper in Europe than here; but the crop is too important to risk any consideration of price, for we find that what are grown as the favorite varieties in Europe are not to be compared for our purpose with those we have ourselves originated here.

Cauliflower seed—Is all imported from Europe. All attempts that we have made to grow the seed here have proved nearly abortive. It requires a cool and rather moist climate, and even under the best conditions seeds sparingly, few varieties being imported at less than $6 per pound, and some of the famous early kinds, such as "Snowball," costing nearly $100 per pound to import.

Celery—Is another important crop that the seed is raised almost exclusively here—at least that in use among commercial gardeners, many of them growing a few pounds for their own use annually at five times the cost they could buy imported seed for; the danger being so great of getting a spurious sort that they prefer doing so rather than run the risk. Now, however, as the varieties best suited for our climate become known, it is largely grown by our regular seed-growers in New York, Pennsylvania, Connecticut, and New Jersey.

Cucumbers—Are now grown entirely here, except a few of the fancy sorts. The best seed is grown on the maiden soil of the prairies, and though still grown to some extent in Pennsylvania, Connecticut, New Jersey, and New York, Illinois and Michigan will, in all probability, eventually be the section used to grow all species of the so-called "vine" family of vegetables.

Carrot—Grown almost exclusively in the States of New York, Rhode Island, Massachusetts, and Connecticut.

Egg-plant—As yet mainly grown in Pennsylvania, New Jersey, New York, and Maryland, but being a plant of tropical origin the seeds no doubt would be better matured if grown further south.

Endive—All imported from Germany and France.

Leek—Partly grown here in the Eastern and Middle States, though some is also imported. The American grown is found to have the greater vitality.

Lettuce—This, when grown in the Atlantic States, matures best in the vicinity of our large lakes, in New York, Michigan, Wisconsin, and Illinois. California, however, is better fitted for seeding lettuce than any

of the Atlantic States, and large quantities are already being grown there. Quantities are yet imported, but in this case, as in the case of cabbage and celery, market gardeners rarely risk imported lettuce until first proving the variety to be correct.

Melon (Nutmeg)—Same as cucumber.

Melon (Water)—Same as cucumber, though rather more of it is grown in States farther south.

Okra—Is of tropical origin, and the seed is best grown in the Southern States.

Onion—Is one of the most important of all our vegetable crops grown from seed, and as it rapidly loses its vitality—being of little value the second year—it is now almost entirely grown here. The seed from which to grow onions of a marketable size is grown mainly in Connecticut, Massachusetts, Rhode Island, and Michigan; while that raised from which to grow onion sets is mostly grown in Pennsylvania and New Jersey. California has begun to grow onion seed to some extent, but as the quality of the seed greatly determines the weight of crop, confidence is not yet fully established in the seed grown there.

Parsley—Is nearly all imported, as the plant is not quite hardy enough to stand our northern winters, while the hot summers of our Southern States is against its maturing there.

Parsnips—Grown mainly in Pennsylvania, New York, Connecticut, and Rhode Island.

Pease—A most important crop, is mainly grown in Canada and in New York State, on the immediate line of Lake Ontario. Large quantities are yet imported from Britain, but the great bulk used are grown as stated above.

Pepper—Grown mainly in New Jersey, Pennsylvania, and New York, but may be grown almost anywhere.

Radish—Nearly all imported, or should be, for when grown in this climate, like oats, it degenerates very fast.

Salsify—Can be grown anywhere where lettuce is grown, but as there is no danger of mixing varieties it is cheaper to import it from France.

Spinach—Nearly all imported from England, France, or Germany, as it cannot be so profitably grown here, for the same reason that we cannot profitably grow parsley, mainly because our winters in the North are often such as to kill off the plants, while in the Southern section the summers are too hot for maturing the seed.

Tobacco—Virginia, Connecticut, and Kentucky, in the United States, and Cuba, and other tropical latitudes. It is sometimes believed to be a peculiarity of tobacco that location changes the character of the variety. This we are inclined to doubt, and believe that the varieties grown in Cuba, Connecticut, and Virginia, are botanically distinct, and are such as have been selected as the kinds best suited to the sections in which they are grown.

Tomato—New Jersey, Connecticut, Michigan, and Illinois grow most of the tomato seeds, but they may be grown with nearly the same success in almost all the States of the Union.

Turnip—Pennsylvania, Rhode Island, Connecticut, and Michigan grow these seeds. A little is grown in Virginia and Maryland, but that is less popular than that grown farther north; but little is now imported.

FODDER CROPS.

Pearl Millet—Is now creating a wide-spread interest. As the plant is tender I am inclined to think the seeds will be grown exclusively in

Florida, Georgia, the Carolinas, and other Southern States, as a long season and high temperature are necessary to fully mature the seed, though the plant as a fodder-plant does well in any section where maize will grow. Last season (1878) under the most favorable conditions we found that the seed did not ripen with us in New Jersey.

Hungarian Millet—or Hungarian Grass, is entirely different from Pearl Millet, bearing no resemblance to it. The plant is hardy. Seeds are grown in New York, New Jersey, and in many of the Western States.

Timothy Grass—Is grown largely in Illinois, Wisconsin and New York.

Blue Grass—Kentucky, Ohio, and other Western States.

Red Top—New Jersey, Kentucky, Ohio, and Rhode Island.

Orchard Grass—Kentucky, Ohio, and the Western States.

Red Clover—Michigan, New York, Ohio, &c.

White Clover—Wisconsin, Illinois, and Ohio, but the greater portion of it is yet imported from Germany and France.

Lucerne or Alfalfa—California mainly.

These localities are now the principal ones where seeds of commerce are grown, but every year, to some extent, these latitudes are changing, as we find that other latitudes are better suited for special kinds. For example, the long, dry seasons of California are found to mature many kinds of seeds far better than any section yet tried in the Atlantic States, particularly so in many of the more delicate kinds of flower seeds, that are yet nearly exclusively grown in Germany and France, and sold to us at rates of many times their weight in gold. Tens of thousands of acres are devoted to the culture of flower seeds in Southern Europe, which could probably be far better done in California, but the industry must be one of slow growth, for seeds are different from nearly all other mercantile commodities, inasmuch as no examination can certainly tell whether or not seed will germinate, or, if it does germinate, can it be known whether it is the variety specified until it matures; hence seed-merchants dare not purchase from the growers until not only their honesty but, what is of equal importance, their *knowledge* of the business in which they are engaged is assured.

BORAX AS A PRESERVATIVE OF BUTTER.

[This Department is indebted to the courtesy of the Secretary of State for the following letter from J. Schuyler Crosby, consul at Florence, Italy, on a subject which seems to be attracting some attention both in Italy and France.]

UNITED STATES CONSULATE,
Florence, Italy, May 10, 1879.

HON. WILLIAM HUNTER,
Second Assistant Secretary of State, Washington, D. C.:

SIR: A number of experiments have been made at the agricultural station at Florence, under the immediate supervision of Prof. Emilio Bechi, in substituting borax for salt in the preservation of butter.

As the success of these experiments has been complete, and the advantages of this plan for the preservation of butter is most clearly shown, I deem it important to make the following report to the Department of State for the benefit of our agriculturists at home.

I am indebted to Professor Bechi for his courteous, prompt, and full reply to my inquiries on the subject.

The opinion has been entertained by the farmers and exporters of but-

ter of Tuscany and Lombardy that the bad flavor often acquired by butter shipped to foreign countries was derived from the salt used in its preservation. Some impurities exist in salt, and especially chlorides of lime and magnesia, and they may give a bad flavor to the butter.

But the analysis made of the salt used in Lombardy shows that it is quite as pure as the salt used in Germany or elsewhere, consequently salt alone could not be the principal cause of good butter becoming bad. The antiseptic virtues of borax being well known, as well as the experiments to preserve meat and other edibles by its aid, it occurred that it might be substituted in butter in place of common salt. On trial it was found not to change in the least the flavor of the butter, and indeed preserved it admirably. But some of the farmers of Lombardy did not concur in this opinion. Great care must be taken to have perfectly pure borax, and particularly that it shall not contain any carbonate of soda or alum. It is necessary also to have the borax reduced to a fine powder and thoroughly mixed with the butter in the same proportion as when common salt is used.

The experiments made at the Agrarian Station of Florence, and also at the one of Cassificio, near Lodi, have given good results, after repeated trials. Doubts, however, arose with reference to the physiological action of the borax, as some people thought it a noxious substance. Mr. Cyon reported to the French Academy on the 25th November, 1878, that borax could be added to food in the proportion of 12 grammes daily without being pernicious, and furthermore, by substituting it for marine salt, it would assist its assimilation. On the contrary, Mr. G. Le Bon stated to the French Academy, on the 9th December, 1878, that borax frequently taken, even in very small quantities, was injurious, and ought not to be used even for the preservation of meats, &c. To this Mr. E. Cyon replied, on the 30th December, 1878, insisting upon the innocuous qualities of borax. But Mr. G. Le Bon reiterated his opinion as to the bad consequences of using it for the above purpose. With this difference of scientific opinion, great circumspection was necessary in adopting the use of a substance which might be very pernicious to health, even if taken in very small doses. At this juncture, Prof. Emilio Bechi, director of the Agrarian Station in Florence, made an important discovery, which throws some light on the question. For a long time Professor Bechi had been occupied in studying the borax mines in Tuscany, and has discovered and analyzed some new borax minerals, one of which Professor Dana, of New Haven, called in his honor Bechilite. Several reports on the borax deposits have been presented recently to the Academy of the "Lincei," at Rome, by its president, Quintino Sella. One by Professor Bechi was read at the academy on the 4th instant, stating the presence of borax in very many of the rocks and in the mineral water of Montecatoni; also in the wells of Florence, in the ashes of plants, and in the air itself. From this fact Professor Bechi argues that neither borax nor boracic acid, in very small quantities, however often taken, would do injury, and that it may be used for the preservation of butter or meats with entire safety.

For his family use Professor Bechi preserves his own butter in the following way: By heat he evaporates the water of crystallization; then he reduces the borax to finest powder, and adds to the butter in the proportions of 6 parts of the former to 100 of the latter, thoroughly and equally intermixed. It is then put into the same sort of jars as are used for salted butter. His method is simply substituting borax for salt. For daily family use he finds that butter keeps fresh in water with only 3 per cent. of borax. Still he admits, although his own ex-

perience shows that borax thus used is innoxious, there are others who disbelieve in his conclusions.

Further, he thinks it might be effectively employed in destroying *phylloxera* on grape-vines, but has made no experiments as yet in that direction.

I have the honor to be, sir, your obedient servant,

J. SCHUYLER CROSBY, *Consul.*

THE DRIED-FRUIT TRADE.

The abundance of the fruit crop of the United States is one of the most gratifying results of the progress of agriculture in this country. With our vast extent of territory, reaching from the temperate to the tropical zone, and the consequent great diversity of temperature and variation of climate, and the light soils and rich loams embraced within these limits, render our country capable of producing almost every known variety of fruit.

The States on the extreme northern limit produce the apple, the pear, and other hardy fruits. In the South and on the Pacific shores there are grown in abundance the orange and lemon, and in more limited but gradually increasing quantities the pineapple and the banana, while the intermediate States are prolific in the production of those fruits adapted to their soil and climate.

More than five millions of peach trees blossom every spring on the fertile lands that lie between the Delaware and Chesapeake Bays, and the interocean region of the Northwest.

The apple crop of the country is almost beyond computation, and the vine product is not less plentiful.

In New England and the Middle States the wild strawberry, raspberry, blueberry, huckleberry, blackberry, and cranberry ripen in the order named, and hundreds of poor families derive a certain income from the picking and sale of these fruits. The yield does not vary greatly from year to year, but as these berries are mainly consumed at home, there are no means of ascertaining the annual yield. It must, however, be very large. They are not only used fresh on the table during their season, but are preserved in large quantities and great variety for winter use, while the strawberry, raspberry, and blackbery are also made into wine and cordial.

The cranberry is largely grown, especially in Massachusetts, New Jersey, and Minnesota, where its cultivation has been found very profitable. The cranberry crop of New Jersey, in 1877, was 50,000, and in Minnesota 40,000 bushels. The crop of Minnesota alone, at a low estimate, yielded $150,000.

The demand for fruit in the markets at home and abroad has been equal to and increasing with the supply. The prices have been generally remunerative, both to the grower and the dealer, and yet low enough to be within the reach of all. The daily use of fruit as food by our people is greatly to be desired. It is not only justly esteemed as a luxury, but is, what cannot be said of many so-called luxuries, productive of health. Yet so abundant is the supply of fruit in some sections that every year a surplus goes to waste, or is utilized only in feeding domestic animals. This is particularly the case with the apple crop of New England. The orchards of that section, and we believe this is the case generally, bear

abundantly only every other year. A large crop so exhausts the trees that they must have time to recuperate. The result is that while one year apples are scarce and dear, the next year they find no sale, and rot on the ground.

To save the great amount of surplus fruit is the subject of important consideration. If properly saved it would supply not only our own country but the chief countries of Europe with table luxuries the year round; and much interest and ingenuity have been manifested in the development of this industry.

The apple crop is the most considerable and the most important. Apple-culture in the United States dates back to a very early period in the history of the country, and has grown by degrees until it has become a very important branch of agricultural enterprise. Wherever the climate and soil have shown a peculiar adaptation to this much-prized fruit it has been extensively cultivated, and experience and intelligence have brought the product to the highest standard of excellence. As an article of food, whether cooked or otherwise, the apple is the most nutritious and wholesome of all fruits.

It is estimated that more than two millions of acres are under cultivation as orchards, and the orchard product of the United States is stated in the census returns of 1870 to be worth $51,334,571. The orchard products of the State of Ohio alone are estimated at $7,000,000 annually.

In the census returns of 1850 the value of the orchard product is given as $7,723,186, which shows, in a period of twenty years, the enormous increase in the value of this product of $43,611,385.

Within the past eight years, and since the last census, the increase of orchard production has been even in a greater ratio, the fruit quality improved by the introduction of new and superior varieties and experienced culture.

The crab-apple is extensively cultivated in many parts of the country. It is a hardy fruit, and will grow in luxuriance wherever the ordinary apple will grow. It is not generally edible or used in cooking for food, but is mainly used in the preparation of jelly, cider, and vinegar. The abundance of its sharp, acid juices, with its constituent parts of saccharine matter, render it peculiarly adapted for this purpose. The cider made from this apple is celebrated for its palatable qualities.

Next to the apple in value, and its excellence in a fresh or prepared state, is the peach; for which, in its cultivation and production, several sections of the United States are justly noted. It is nowhere so largely cultivated as in this country, which is said to be the only one in which this delicious fruit is within the reach of all classes.

In New Jersey, Delaware, and Maryland the cultivation of the peach has been for years a valuable industry, and has given this section the name of the peach garden of the continent. In these States are many orchards counting 10,000, 20,000, and 30,000 trees, yielding an annual crop of immense value. On one farm in Maryland of 1,350 acres there are 136,000 trees.

The peninsula of Delaware and Maryland, in ordinary good seasons, sends to market from 7,000,000 to 8,000,000 baskets of peaches, amounting in value to $1,500,000.

Another important peach district is on the lake shore of Michigan, which, though so far north, has its climate modified by the proximity of large bodies of water. This region produces profitable crops, estimated at $1,000,000 in value annually, which find their market in Detroit, Chi-

cago, and other Western cities. One grower in Michigan sells his peach crop from an orchard of 12 acres for $12,000 per annum.

Ohio, Illinois, Indiana, Missouri, and Kentucky also produce large quantities of this fruit.

In several of the Southern States, Tennessee, Georgia, Texas, &c., peach-growing is receiving careful attention, and profitable crops of excellent varieties are the result. In California the production is very large.

The estimated annual peach crop of the United States is valued at $56,135,000.

Large quantities of apples and peaches are consumed in the manufacture of apple and peach brandy—the former being known in the Southern States and New Jersey as "apple-jack." Some of the peach-canning establishments also utilize the skin of the peaches, making from them a very fair article of brandy.

Throughout New England and in the Northern States a great many thousand gallons of cider are made in the apple years, which is used when new, or after it undergoes fermentation and becomes "hard," as a beverage. Much of it is allowed to go through still further fermentation until it becomes a vinegar, which is scarcely inferior to the best white wine vinegar, and finds a ready and remunerative sale.

Much attention has been given to grape-culture and the manufacture of wine. Two hundred thousand acres of land are planted in vineyards, and the grape crop amounts in value to $2,118,900, the whole wine-product being 15,000,000 gallons.

Pears are grown in great abundance, the annual crop being valued at $14,130,000.

The orange flourishes in California and the Gulf States, but only in Louisiana, California, and Florida is it extensively cultivated, the soil and climate of the two last named States being specially adapted to its needs. Florida oranges always command a much higher price in our markets than those grown elsewhere, and are certainly superior to the imported fruit. The yield from a single tree has reached the almost incredible total of 30,000 oranges, and an industry which has proved so profitable to those engaged in it cannot fail to rapidly increase in extent and value.

The lemon also thrives in the Gulf States, though but little attention has thus far been paid to its cultivation. There is no reason why it should not be made a profitable crop.

The fig grows in California and in the Middle and Southern States, but attains its greatest perfection in the Gulf States. Nowhere else is this fruit so luscious and so tempting, the small purple fig of Louisiana and Texas fairly bursting open, when ripe, with its own sweetness. In its season it is a welcome addition to the breakfast table, and at dinner it is not the least attractive portion of the dessert; but no attempt is made to utilize what is not thus used, and the birds and poultry generally dispose of the surplus crop. It would seem that the new system of evaporation might be applied to the fig with the happiest results, and thus supply a new article for domestic use and exportation.

With regard to a long list of the smaller fruits, such as plums, berries, &c., it may be said that while they can be abundantly and profitably grown in the Southern States, they have, save in a few sections, received but little attention. There is, however, a growing interest in that direction, and before many years the waste places in the vicinity of southern towns and cities will be profitably utilized as market-gar-

dens. This has already been done to some extent in the vicinity of New Orleans.

The writer once visited a fruit-farm on the Mississippi, a few miles above New Orleans, which was established a few years after the late civil war, and in walking over the acres of strawberry-beds the proprietor remarked that save in exceptionally cold seasons he could send strawberries to market every day in the year. The river communication enabled him to send his fruit to market in perfect condition, and the enterprise had proved a very remunerative one.

The estimated value of the strawberry crop is $5,000,000.

In California it is reported that there are sixty thousand acres of this fruit under cultivation. Virginia is largely interested in its cultivation, and immense quantities are shipped thence to the markets of the northern cities.

The consumption of strawberries in the cities named below, in the year 1877, was as follows:

	Bushels.
New York	58,000
Philadelphia	19,000
Boston	18,000
Cincinnati	16,000

In 1877 there were shipped from Virginia over 3,000,000 of quarts, and there were ten thousand pickers in the fields gathering the fruit at one time. There is one farm of 185 acres exclusively planted in strawberries.

In the same year there were shipped to Boston from various points 11,547 crates of strawberries of 45 quarts each, or more than 16,000 bushels. The shipments of strawberries from Cincinnati in one week in June, 1877, reached 17,000 bushels.

The statistical returns of the United States give as the value of smaller fruits other than those mentioned the sum of $10,432,800, making a total valuation of the whole production of fruits in the United States of $138,216,700, a sum nearly equal to one-half of the wheat crop of the country.

American fruit is held in high estimation in Europe, and the foreign trade in this article alone is becoming one of great value to our merchants. The first shipments of apples to Great Britain were made from Boston some thirty years ago, and were confined to one variety, the Newton Pippin, a small green-colored but fine-flavored and juicy apple, which was greatly esteemed in England. These early shipments brought the then unheard-of prices of $6 to $8 per barrel, the result of which was to take the Newton Pippin entirely out of the home market.

There were shipped from Philadelphia to England last year 1,500 barrels of apples, and the port of Liverpool received of American apples 90,000 barrels. From New York it is estimated that in abundant years one and a half million barrels are exported to foreign countries. Large quantities are shipped from Boston.

The whole amount of exports of fruits of all kinds for the year ending June 30, 1877, was valued at $2,937,025.

It can be seen by the above figures that fruit-culture has become a vast industry, realizing valuable profits, giving employment to thousands of people, and supplying business through every artery of trade.

This trade in fruits will be augmented from year to year by the introduction of refrigerators on railways and steamers, by which the more delicate fruits can be transported in fresh condition to and from all parts

of the country, and to other countries wherever the United States have commercial relations.

Preserving fruits by canning in hermetically sealed tin-cans was introduced a few years ago as an experiment, and succeeded so well that it has grown into an important business. It was begun in Baltimore on a small scale more than twenty years ago, and that city still maintains its supremacy in this trade, having established a number of large factories for the purpose, and employs, during the canning season, great numbers of men, women, and children in the various stages of the preparation of the fruit.

There are now establishments of this kind in Michigan, Delaware, Illinois, and other States, and all give evidence of increasing business and profitable results. Nearly every kind of fruit is now preserved by the canning process.

The export of canned fruits, together with canned vegetables and meats, to foreign countries is largely on the increase, and, although considered as merely in its infancy, has assumed a magnitude that brings it within the range of one of the most important industries of the country. Canned fruits and vegetables are held in high estimation in Europe, for the reason that they can be supplied cheaper than fresh fruits and vegetables, although the shipment of the latter is rapidly on the increase.

Canned fruits exported in the year 1877 amounted in value to $762,344. The yearly aggregate of the export trade of canned goods, which includes meats and vegetables, ranges from 300,000 to 400,000 cases, averaging 60 pounds each, in one, two, and three pound cans, making a total export of 21,000,000 pounds, and valued at more than a million dollars. Large cargoes of these goods are shipped to Great Britain, France, Germany, Austria, Italy, Turkey, Russia, Norway, Sweden, Egypt, and Australia.

American exhibitors of canned fruits at the recent exposition at Paris report unusual interest attached to their goods, and the receipt of many orders for the same on the part of dealers in Paris and elsewhere, which fact will result in a very considerable increase in the foreign consumption.

Preserving fruit by drying in the sun is a practice in the countries of the East as old as the introduction of fruit itself. In France, Spain, Italy, Turkey, and Egypt this practice still prevails, and the figs, dates, prunes, currants, and raisins so largely imported are dried in these countries by this original method. In Normandy they dry the apple whole.

Dried fruit, by the reduction of more than half the weight by the removal of water, is more easily transported, and thus prepared may be shipped to any climate and preserved perfectly for years.

Former publications by this department have given in detail the methods of gathering, drying, and packing foreign fruits for commerce, and they need not be further mentioned here.

This primitive method of drying fruit in the sun is extensively practiced in the United States. Everywhere throughout the Middle and Southern States may be seen at the farmsteads, in the early fall, rows of boards covered with sliced fruit and tilted up to the sun. It is thus prepared for home consumption or barter at the village store. Even the convenient little machine for paring and coring has not yet come into general use. The work is done entirely by hand by the women of the family.

In New England the apples are pared, quartered, and then strung with a needle, after which they are hung on the sunny side of the house, or on a convenient out-building, to dry. In wet weather they are brought into the house and hung by the kitchen fire. Many families prepare a

supply of blackberries, blueberries, &c., for the winter by drying. They are spread on newspapers in an unoccupied room or sunny garret, and when dried resemble in appearance the dried currant of commerce. When required for use they are soaked in water, which restores them to nearly their original plumpness.

These berries are now canned in large quantities. The canning establishments in some of the States are located on the berry-plains, where the pickers congregate from miles around, whole families dwelling in tents or rough board shanties until the season is over. The pickers are paid from three to four cents a quart, and so abundant are the berries that at these prices good wages are realized.

Sometimes the sliced fruit is spread between sheets of muslin to keep away the insects, and to give the fruit a finer color. These small lots of fruit are gathered by the country store-keepers, and thus find their way to the great cities and a market.

The first improvement made in drying fruit was tried in New England, and consisted in putting it under a covering of glass. The hot-bed sash lying idle in the barn found a new duty. Wooden boxes or frames made to fit the sash were prepared and set upon legs to raise them from the ground. Holes were cut at the front near the bottom, and at the back near the top, to secure a current of air through the frame; within these glass-roofed frames the fruit was spread on trays in the full sunshine. The glass kept out the rain, protected it from depredations of birds and insects; and the fruit, it was claimed, was improved in appearance.

Then followed experiments of drying by stoves. The cooking-stoves dried the fruit more quickly than the sun, but they were wanted for other purposes; in addition, the fruit dried in this way was not so sweet as that dried by the sun, nor was the color so good.

One of the first known inventions for drying fruit by artificial heat was made by an ingenious farmer—a cheap, rude contrivance which answered his purpose, and with which, in the space of a few hours, he effectively dried his fruit. It was composed of three things, viz: A hogshead, a fruit-tree shipping box, and a small stove. The hogshead stood on end, and had a door sawed out of the side to admit the stove; a hole eighteen inches square was sawed in the head of the hogshead to let the heat of the stove up, and a six or seven foot box, such as was used to ship a thousand pounds of fruit, stood on end on the top of the hogshead, having the lower end knocked out, and was fitted carefully over the hole in the head of the hogshead. The heat ascended from the stove through the top of the hogshead and on through the box. A pipe-hole was made in the hogshead opposite the door to let the smoke out, so that none of it ascended through the box. The lid of the box was fitted with hinges, and cleats were put in on which to rest the open shelves or crates which held the fruit. The stove was heated by coal or wood.

Stimulated by the increase and importance of this industry, the rude methods for drying used in the beginning soon gave way to improved processes, until, at Baltimore and in other cities—depots for the accumulation of large quantities of fruits—extensive establishments have been erected, furnished with the most improved machinery and appliances for the rapid drying and evaporation of fruit, and with capacity for an immense amount of work.

The principle of these processes may be described, in general terms, as follows: An elongated chamber or shaft is provided, square, oblong, or other form in cross-section, and set vertically or in any other position found advantageous for particular purposes. This may be designated as the pneumatic shaft. In one end of this pneumatic shaft is placed a

steam-coil, the pressure and heat in which are regulated to suit the product in hand. Next the steam-coil is placed a deflector to distribute the air-blast more uniformly throughout the shaft. This may be adapted to hold a deposit of water, which is sometimes desirable for giving a degree of humidity to the air-blast at its first entrance to the shaft; or deposits of water may be arranged at other points and in other modes to supply the humidity, which is an essential element in the process of preserving organic products. Behind or beneath the steam-coil is an air-chamber, into which air is forced by a suitable apparatus, such as a fan blower. The material under treatment, having been first divided so as to expose the most extended surface possible to the action of the pneumatic apparatus, is spread on a screen and may be introduced into the pneumatic shaft at the end near the steam-coil. After remaining here exposed to the blast for a suitable time, according to its nature, it is passed onward by a movement of the carrying apparatus on which it rests, and a fresh screen (or screens) is introduced into the place thus vacated. The blast in passing through these screens covered with fresh material now carries with it an increased burden of moisture derived from them as it strikes upon the screens that have gone on before. With every forward movement of the carrying apparatus fresh screens are introduced, and the moisture of the blast is increased by them. When the pneumatic shaft is filled with the series of loaded screens they begin to be taken out at the terminus of the shaft, in a perfect condition of the material, as fast as the crude material is introduced at the entrance. The process is now in full operation. The blast, which enters the shaft with a slight degree of humidity and a temperature of from 175° to 200° Fahr., according to the article, gains moisture and loses heat at every loaded screen through which it passes, and finally leaves the perfected material at the terminus reduced in temperature to say 100°, and yet throughout its progress does not cease to act at once as a hydratic mediator in the conversion of the starchy ingredients to grape sugar, and also as a mechanical evaporator and absorbent, with such effect that the amount of free moisture left in the material at the terminus is of no practical consequence, and never produces fermentation or decay.

The temperature of the air in the lower part of the tower is from 190° to 200° Fahr., and as the air rises it gradually cools off, so that in the top part of the tower the temperature is from 120° to 130° Fahr. These temperatures are maintained in drying fruit, such as apples, peaches, tomatoes, &c.; but for other substances the temperature must be varied, as experience will dictate. For drying meat, for instance, the temperature may be slightly decreased, and it must not rise above 150° Fahr. in the bottom part of the tower.

By introducing the green articles in the bottom part of the tower and moving them in the same direction in which the air moves a great advantage is gained, since the air on coming in contact with the green articles takes up a quantity of moisture, and as the air rises the quantity of moisture taken up by it constantly increases, while at the same time the moisture contained in the articles spread on the successive screens constantly decreases. By this process the skin of the articles to be dried is prevented from becoming hard, and the articles are thorough and uniformly dried. *Per contra*, if the screens were introduced at the top of the tower and moved against the current of the air, the articles to be dried would become hard, and the interior of these articles would be imperfectly dried.

It is claimed by the inventor of these improved methods of drying fruit that growth and development in the vegetable, as also in the ani-

mal, kingdom are gradual and progressive processes. In the tasteless state they consist of little more than the substance of the leaf, of vascular or woody fiber, filled with a tasteless sap, and tinged with the coloring matter of the green parts of the plant. But after a time this fruit becomes sour to the taste, and its acidity gradually increases. This formation of acid proceeds for a certain time, the fruit becoming daily more sour; the acidity then begins to diminish, sugar is formed, and the fruit ripens. The acid rarely disappears, even from the sweetest fruits, until they begin to decay; a considerable portion of it, however, must be converted into grape-sugar as the fruit approaches to maturity. From experiments it is known that when unripe fruits are plucked they do not ripen if excluded from the access of oxygen, but that in the air they ripen, absorbing oxygen and giving off carbonic acid.

Many fruits pass, in the course of ripening, from a sour to a sweet state. Apples, pears, peaches, currants, cherries, &c., are of this kind. Most of them even when fully ripe are still a little acid, the mixture of sweet and sour in their juices adding to their agreeable and refreshing qualities. All such fruits, as a general rule, contain and owe their sweetness to the presence of grape-sugar. From many of them this sugar can readily be extracted for use; but in general it is more economical and agreeable to employ it in the form of dried and preserved fruits. By continuing the conversion of acid into grape-sugar, and at the same time, by the rapidity of its action, arresting the natural tendency to decay, there is produced upon the fruit or vegetable a twofold effect, viz., mechanical and chemical. For instance, if a piece of apple which it is purposed to dry is subjected at first to a very hot and dry atmosphere the surface moisture is immediately driven off, and a thin, dry film forms, which soon increases in thickness, and, as it were, seals up the water which is contained in the interior of the substance. All subsequently evaporated moisture must pass through this skin, and in so doing the juices of the fruit are brought to and deposited upon the surface, and the result is the center of the piece is but little affected, while the surface is hard and incrusted. Fruit dried in this way is always inferior in color, flavor, and saccharine matter.

If, on the other hand, the fruit enters into a moderately warm and saturated atmosphere, the moisture is liberated so gently that the juices are not disturbed and the surface is not incrusted. As the fruit advances in the chamber through strata of air gradually increasing in dryness and temperature, the evaporation proceeds with corresponding rapidity. The water separating uniformly from the solid constituents of the fruit, which undergoes at the same time a chemical change, the acid and the starchy parts are converted into grape sugar. This chemical action has been demonstrated by actual analysis, as well as in theory; but what is far more to the point in a business point of view, it is distinguishable by the ordinary senses. An apple-pie made from fruit evaporated by these processes cannot be distinguished from one made from fresh fruit, and yet only one-half of the quantity of sugar is needed to sweeten it; and the same fact is true in regard to tomatoes and all other fruits and vegetables. Peaches can be soaked in water and eaten with cream. In appearance, flavor, and keeping qualities fruits and vegetables prepared by this method are vastly superior to those dried in the ordinary manner.

In the various methods of preparing fruit, it has been found that the greatest elements of decay are worms and insects, and it has been difficult to find some means to prevent the development of insect life. The inventors of the new process claim to have accomplished this by the

agency of hot water or steam previous to introducing them into the drying chamber, a process resulting in the total destruction of every germ or spore of animal life. Other advantages claimed are in reducing the time required to dry the fruit and causing the flesh to retain its natural color, so that the delicate green of the russet apple can be distinguished at a glance from the golden yellow of the pippin.

There has more recently come into use an iron stove or drying-machine, constructed upon the same general principle as the more extensive and elaborate one above described, but complete in its essential points and of simple construction. This stove is made at a comparatively small cost, and can be used in drying all kinds of fruits and vegetables. It is portable, and may be used out of doors or in a building, as may be most convenient.

A fruit-growing neighborhood might subscribe for one of these stoves, and it could be used for the benefit of all, making the cost, thus divided, comparatively trifling.

A fire is kept up in the fire-box at the base, and above it are movable shelves for apples, peaches, berries, corn, grapes, or other fruits and vegetables. A constant stream of hot air passes through the apparatus, sweeping across the trays of fruit and quickly extracting all the moisture. The smoke-flue from the fire passes through the escape for the hot air, and materially assists the movement of the air.

Drying machines of this inexpensive character are much used in the peach districts of the Eastern States and in the grape-growing country of the Pacific coast. They are described as easily managed, and will dry as much fruit in a day as a family can peel and slice in that time. In California these machines are used in curing prunes and raisins, and it is claimed that the fruits thus prepared are equally as good as the imported articles. The cost of the apparatus is about $75.

Kilns are used in some parts of the country in drying fruit; but as the fruit dried in this way, by means of dry heat, is not considered by dealers as very marketable, they are not of general use, and are giving place to the more convenient and modern process.

Sulphurous acid gas has been employed in preserving fruit. This gas, it is claimed, possesses the power to destroy all infusoria and animalcules, and fruit properly saturated with it may be preserved indefinitely. The mode of applying the gas is by immersing the article to be preserved a sufficient length of time in a solution of sulphate of lime or soda, and then drying. About two or three pounds of the sulphate of soda to a barrel of water is given as the proportion for ordinary purposes.

All kinds of salads and delicate vegetables, such as onions, asparagus, celery, pease, Lima beans, and others already named are preserved by these new processes, fresh and dehydrated, like the fruits, for all seasons of the year and for all markets of the world, returning at any time when desired for use, in water, to their original fullness, color, flavor, and other properties.

Preserving fruits by drying in these improved methods has worked a revolution in the dried-fruit trade, and adds a large percentage to the production available from every acre of the soil. The result will render the products of all climates common and accessible to all others, and provides the poor in all seasons with luxuries which the rich alone have heretofore enjoyed. The trade in these articles will, as a consequence, be augmented to one of still greater importance.

The United States annually import 32,931,736 pounds of raisins, 17,654,637 pounds of prunes, and 3,873,884 pounds of figs.

The business of raisin-making in California is growing very rapidly.

The product last year was about 25,000 boxes of 20 pounds each, and this year it is expected there will be made, from the excellence and abundance of the grape crop, at least 40,000 boxes. It is only a question of time, and the discovery of the best process, which shall place native raisins on a par with the imported fruit. With so large a country for a market, and conditions of soil and climate so well adapted to the production of raisins, and the gratifying success that has already attended the efforts in this line of industry, there is every encouragement to believe that in a few years the United States will supply the home markets with this luxury.

Prunes are also made in California to a considerable extent, and find a ready market. Those raised and made in Germany and France are sold at from 15 to 50 cents per pound, the highest-priced being the choice prunes of Bordeaux. Any land that will produce good apples will answer as well for prunes.

It is a fact well known in the trade that the supply of dried fruits has never yet been equal to the demand. The extraordinary increase in the production which has taken place during the past few years has been met by a still greater consumption.

The dried-fruit trade, having its beginning in the small quantities bartered at the village stores and gathered for market use, has grown with the increasing population and by the increasing consumption to such an extent that few have any idea of the value or volume of the business. As no census of this trade has ever been taken, and the reports of boards of trade of cities and statements of railways, &c., give no precise data as to receipts and shipments, it is with great difficulty that an exact idea of its value can be ascertained. Leading facts, however, from the most important points, and a general average and comparison as to other points, may enable one to arrive at an approximative idea of the extent and value of this industry.

New York is one of the largest fruit-producing States in the Union, and the great bulk of its trade is marketed at Buffalo, which is its chief distributing point.

The secretary of the Board of Trade of Buffalo, in writing to the department on this subject, states that the dried-fruit trade of that city has beeen growing rapidly for the past twenty years, and has reached very large proportions, as will be seen from the following data:

Nearly the entire product of the Western New York orchards is marketed at Buffalo, it being the leading distributing point. Dried fruits are purchased from farmers and others by local dealers generally and then consigned to merchants, who assort the fruit into the recognized qualities and brands.

The receipts and shipments by the railroads centering at Buffalo are not specially recorded, but are included under the heading of "miscellaneous" or "products of the farm or garden;" and no figures are kept of the movement by lake, that being included under the heading of "sundries."

The imports of dried fruit by canal at this port for the past three years compare as follows, viz: 69,845 pounds in 1875; 35,025 pounds in 1876; and 6,695,652 pounds in 1877. The exports for the same years were: None in 1875 and 1876, and 2,800 pounds in 1877. This statement of imports is made up of all kinds of dried fruits, and nearly all of foreign growth. The large increase in 1877 was on account of taking off the tolls on the canal on plums, prunes, currants, raisins, &c., turning the freight from the railroad to water-way.

The following statement shows the number of tons of dried fruits left

at New York by canal boats, loaded on the Erie, Oswego, and other canals of the State of New York, without breaking bulk at West Troy and Albany, for a series of years:

Year.	Tons.	Year.	Tons.
1868	29	1873	46
1869	44	1874	None.
1870	12	1875	39
1871	52	1876	None.
1872	92	1877	3

No division is made at the State canal office at Albany of the different kinds of fruits, whether of foreign or domestic growth, for the reason that each canal-collector simply specifies "all kinds of fruit" under the one heading.

The imports of dried fruits from the Dominion of Canada for the year 1877 cannot be ascertained, for the reason that the imports are classed under the heading of "fruits of all kinds."

The trade in dried apples is yearly becoming of larger proportions, for the supply of the foreign demand, principally from Hamburg, Rotterdam, and Bremen, as well as small orders from Great Britain and Ireland, and a permanent and growing market is confidently looked for by dealers.

The estimated quantity exported from Buffalo via. Eastern seaboard ports in 1877 2,000 barrels, averaging 225 pounds to the barrel; while in 1876 the shipments were about 5,000 barrels. This year (1878) the aggregate business may not reach the earlier expectations of the trade, for the reason that the fruit crops on the Continent of Europe are reported to be large and of good quality, and there may not be a sufficient margin of profit in prices to justify heavy shipments this fall and early winter. Quartered apples, cored and uncored, are the only kinds taken for the export trade.

The movement in dried apples is not confined to any particular season; the demand being for consumption, they are sought for at all periods of the year. The locality supplied depends entirely upon the condition of the fruit crop in any particular section. Failures of the fruit crop from natural causes in any part of the United States, or on the Continent, produces a necessity for a substitute or an equivalent from some other portion of the country, &c., and as this is of yearly occurrence, a steady trade is constantly maintained.

Dealers always hold large supplies to meet emergencies, and exercise great care and judgment in the selection of the dried fruits and the packing of the same.

The sources of supply of the dried apples sold in this market are all the counties in New York west of Onondaga and bounded by Lakes Ontario and Erie, viz: Niagara, Orleans, Monroe, Wayne, Genesee, Cayuga, Ontario, Yates, Erie, Wyoming, Allegany, Steuben, Chautauqua, and Cattaraugus; also from the northern part of Pennsylvania bordering on Lake Erie.

Wayne County is the largest drying county in the State; Cayuga, Cattaraugus and Chautauqua Counties come next in order, followed by Wyoming, Genesee, &c. Wayne County dries none other than sliced fruit; the other counties mostly quarters.

New York State fruit is the most desirable in the market, not only for home consumption but for the foreign demand, for the reasons, first, the fine qualities of the apples grown; and, secondly, the great care taken in their preparation and packing.

In 1876 the crop of green apples in the districts before mentioned was very large, and the supply of dried fruit in consequence correspondingly large. In that year the estimated quantity of dried apples handled and sold in Buffalo was from 5,000,000 to 6,000,000 pounds. In 1877 the crop of apples was moderate, and only about half the quantity named for 1876 of the dried fruit was sold, for the reason that dealers both in the United States and on the continent of Europe were overstocked. Large supplies of the crop of 1876 remained on hand at the close of that year.

Each dealer has a particular brand by which he sells and the quality of his fruit is known, such as the standard best brand of "Circle A," "Excelsior A," and "Jupiter A," which have the reputation of being first class, and pass among the trade without reinspection.

The grades of dried apples are as follows: First quality consists of sliced fruit; second quality, cored quarters; and third quality, of uncored quarters and darkish fruit. A strong effort is being made by the dealers to do away entirely with the uncored fruit.

The range of prices during 1877 was as follows:

	Cents per pound.
Selling, sliced fruit	5 to $7\frac{1}{2}$
Selling, cored quarters	5 to $7\frac{1}{2}$
Selling, uncored quarters	$3\frac{1}{2}$ to 4

A fair trade is transacted with the Dominion of Canada, principally of the choice brands for the fancy domestic trade. The lumber districts take small parcels of inferior graded fruit.

During the year 1877 evaporated apples, prepared in some interior towns, were placed to a limited extent on the market. These apples were prepared principally by what is known as the "Alden process," whereby the flavor, richness, and fresh qualities of the fruit are preserved. Slices of apple, after passing through the evaporation process not thicker than a knife-blade, become, when placed for a short time in water, as thick as a finger. Occasionally pears, quinces, peaches, and other fruits prepared by the above method find their way to the fancy grocery stores, but no large sales are effected, the dealers merely purchasing for the immediate requirements of the retail trade for consumption.

The domestic or home-dried small-fruit trade does not grow in the ratio that it was expected to a few years since, taking into consideration the increasing population of this and other neighboring places, for the reason that the system of canning fresh fruits is carried on very largely and with much care; the qualities of the berries by this method are preserved with great perfection, and the fruit is supplied at so small a cost that housekeepers prefer the canned article.

The selling year of dried small fruits commences about the 1st of September and ends with the incoming of the new fresh fruit crop of the following season; business fluctuating, of course, like all other trades, from various causes.

The quantity of the crop of 1877 may be briefly summed up thus: Blackberries not large; black raspberries moderate; cherries and peaches large; the quality of the fruit good.

The estimated receipts of small dried fruits during the year 1877 were as follows: 300 barrels of blackberries; 150 barrels of black raspberries; 100 barrels of pitted cherries; and 300 barrels of pared peaches. Peaches are never brought to this market unpared. A barrel of blackberries or raspberries contains about 175 pounds of fruit, and cherries and peaches 200 pounds.

Prices ranged during the year as follows: Blackberries, 8 to 11 cents; raspberries, 22 to 28 cents; pitted cherries, 15 to 16 cents; and pared peaches, 8 to 10 cents per pound.

The distribution of the fruit received at Buffalo is thus reported by dealers: Peaches to New York and Pennsylvania; blackberries, raspberries, and cherries to western markets. The lumber, oil, and coal districts draw their principal supplies from Buffalo, and lake vessels carry small quantities to points in Michigan, Wisconsin, and Minnesota. The home trade is fair, and confined to the finer quality of berries. No direct or indirect shipments are made to Europe or other foreign countries from Buffalo.

The export trade to the Dominion of Canada is light, as the duties are almost prohibitory.

With regard to the supply of small dried fruits in this market, the range of country producing them may be drawn on the map of New York from Onondaga County to Lake Ontario and Lake Erie and the northern part of Pennsylvania to Lake Erie. The receipts from Erie County are not large. The finest dried peaches and raspberries are received from Orleans, Niagara, Monroe, and Wayne Counties.

But few native-grown plums are handled in this market. The Western New York fruit is generally sent East by the growers of it. Small parcels of plums are received from Virginia, North and South Carolina, Delaware, and Maryland. Cherries and raspberries grown in New York are preferred to those sent from the South, the flavor being finer, and greater care is used in their preparation; as a consequence they bring from two to three cents per pound more in this market than the Southern product.

The estimated value of the dried fruit sold during the year 1877 in Buffalo is shown by the following figures:

Sales of dried apples	$155,000
Sales of blackberries	5,000
Sales of raspberries	7,000
Sales of cherries	3,500
Sales of peaches	5,500
Total	$176,000

At Chicago, the trade in dried fruit is very large, as it is a distributing point of considerable importance for the West and Northwest.

The secretary of the Board of Trade of that city, in a report to the department, states the receipts of dried fruits for the year 1877 to be as follows:

Dried apples, 30,000 barrels of 200 pounds each.

Dried peaches, 18,000 barrels of 250 pounds each.

Of the smaller dried fruits and berries a proportionate amount was received.

The sources of supply for dried apples, are, in the main, Michigan, New York, Ohio, Indiana, Illinois, Kentucky, Tennessee, and North Carolina, the quantity received from each being in about the order named. For dried peaches, Southern Illinois, Southern Indiana, Missouri, Kentucky, Tennessee, Georgia, North Carolina, and Ohio, in proportion as named. Also, about 3,000 pounds from California and Utah. Blackberries come almost entirely from North Carolina.

As to values, it is very difficult to form an intelligent estimate, differences in growth and quality making an average value less in the absence of the proportions of each. In the amount of receipts given only such as are consigned to the merchants are included; considerable quantities

in addition are distributed from points of production to those of consumption; these may amount to as much more. Dried blackberries are an exception to this, however, as nearly the whole of that trade of the Northwest centers at Chicago. The California dried peaches are much the most valuable, while dried apples from that State are not at all in favor.

The general trade in dried fruits is not increasing, the demand being supplanted within a few years by the great increase of canned goods of all sorts, and, in addition, the States of Iowa, Wisconsin, Kansas, and other portions of the West, formerly large consumers, are now producing enough, or more than enough, for their own consumption.

The trade from California and Utah is being distributed in larger proportions than formerly through direct points for the West, thus saving something in transportation.

From the report of the Chamber of Commerce of Cincinnati, for the year 1877, the following facts relating to the trade at that point are obtained:

The crop of green apples having been very large in 1876, the supply of dried fruits of this kind has been correspondingly large. The market in September and October was filled to repletion, the dealers not knowing, with the abundance of green fruit, what was to become of the accumulation. An export demand sprung up in the winter, relieving to some extent the market, and preventing prices from going as low as they would otherwise have done. Still, prices were low, and so remained throughout the year. Southern apples were at one time as low as 3 @ 3¼ cents per pound, and northern fruit about ½ cent higher. The average quotations for the year were 4 @ 5 cents per pound, compared with 10 @ 18 cents in 1875 and 1876.

The year closed with large supplies of old fruit, with stronger feeling, predicated on a light crop of green apples. The new southern apples which have appeared have commanded 3½ @ 4 cents per pound. The stock of dried peaches at the commencement of last year was light. The crop of 1876 was a slender one, and the markets sparingly supplied. Still, prices dragged the year through, affected by the poor quality of the peaches and by the relatively low prices of foreign fruits. Peaches in limited quantities were brought from California and Utah which were fair in quality, some of the fruit being singularly sweet and palatable. The average quotation for the year was 11 @ 18 cents per pound, compared with 12 cents in the preceding year, and 8.68 cents in 1874-'75.

The receipts of dried fruits for the year have been 146,501 bushels, in comparison with 102,329 bushels in the preceding year.

Notwithstanding the general business has labored under somewhat unfavorable features, the receipts have been exceeded by only two years in the history of the business.

The trade in Baltimore, where the first substantial improvements were made in the methods of drying fruit, is very considerable. Messrs. Wilson, Burns & Co., leading merchants in that city, in a letter to the department, state that the amount of fruit received for the season of 1877, of all classes, was about 4,000,000 pounds, and came from the following States, viz:

	Pounds.
Virginia	500,000
North Carolina	1,500,000
Tennessee	1,500,000
Georgia	500,000
Total	4,000,000

Of this amount, 1,500,000 pounds of peaches, peeled and unpeeled. can be fairly estimated, say—

1,000,000 pounds unpeeled, valued at 5 cents	$50,000
500,000 pounds peeled, valued at 7 cents	35,000
1,500,000 pounds apples, valued at 4½ cents	67,500
700,000 pounds blackberries, valued at 6 cents	42,000
50,000 pounds raspberries, valued at 20 cents	10,000
200,000 pounds cherries, valued at 13 cents	26,000
50,000 pounds whortleberries, valued at 9 cents	4,500
Making total value of receipts	$235,000

The dried-fruit product of North Carolina alone is valued at $400,000 annually.

As the producers are taking more care of their fruit, the quality of the dried article has greatly improved of late years. The greatest improvement has been noted in apples, especially so with sliced apples, which now come to market from some sections perfectly white, well cored, and thin as paper, which quality always brings the highest prices and is used entirely for domestic purposes, being consumed principally in the Upper Lake regions, Canada, and Eastern British Possessions.

The quarter-sliced apples, that is to say, an apple cut into from six to eight pieces, well cored and pared, are also largely received in Baltimore, and is the only style of dried fruit that is exported to any extent, as the foreign markets call for this class of goods entirely. Very few peaches or small fruits go abroad.

The machine-dried fruits are generally much brighter and bring higher prices, and for these reasons do not come in competition with the sun or kiln dried fruits. It is claimed by the owners of the patent driers that the fruit contains more of the saccharine matter; but properly sun or kiln dried fruit, in the opinion of dealers, is as good and contains as much of the original value of the fruit as the machine-dried fruit possesses.

The prices for 1877 were lower, in comparison, than in former years, from the fact that there were two large crops, especially of apples, and not all being consumed, the surplus was preserved in cooling-houses and carried over to 1877, and came in direct competition with the new crop. This had a tendency to keep prices low; but the main reason was from the fact that the duty on foreign dried fruits had been greatly reduced, particularly as to prunes, which, coming in competition with the domestic dried fruits, and having the preference with most consumers, had a disastrous effect on the prices, and hence the low figures obtained on the domestic fruits.

Messrs. T. M. Bartholomee & Co., of Baltimore, writing to the department on this subject, state that, in the year 1876, the shipments of dried fruits to Europe were enormous, their house alone selling for the German market over two millions of pounds; that the succeeding year, on account of the large crop in 1876 and the market being overcrowded, the exports were not so great, but that there was a steadily increasing foreign demand.

The only authentic information in regard to the trade in Saint Louis is given in the following table:

DRIED FRUIT TRADE OF SAINT LOUIS.

Receipts and exports for eleven years.

RECEIPTS.				SHIPMENTS.			
Years.	Sacks and barrels.	Years.	Sacks and barrels.	Years.	Sacks and barrels.	Years.	Sacks and barrels.
1877	66,335	1871	37,598	1877	44,425	1871	37,471
1876	32,359	1870	27,326	1876	45,391	1870	28,469
1875	38,655	1869	34,413	1875	69,134	1869	23,307
1874	37,745	1868	33,960	1874	58,449	1868	31,328
1873	37,384	1867	24,023	1873	42,006	1867	17,583
1872	44,853			1872	34,550		

From the report of the Board of Trade of Louisville, Ky., it appears that the receipts of dried fruits from the South have been an important feature of the commercial affairs of the city, and the business is constantly increasing in magnitude. During the last year the receipts of apples and peaches have been upon a liberal scale, and prices have created demands.

The secretary of the Chamber of Commerce of Memphis states that the total receipts of dried fruits in that market for the year 1877 comprised in the aggregate 4,448 barrels, of which 2,218 barrels were transshipped to other points. The receipts comprised equal amounts of apples and peaches, and were valued at $44,000.

The report of the Chamber of Commerce of the city of Richmond gives the receipts for the year 1877, as follows:

	Pounds.
Dried apples	400,000
Dried peaches	50,000
Dried blackberries	20,000
Dried cherries	15,000
Dried raspberries	1,000
Dried whortleberries	2,000

In Detroit, which is the center of a large trade in canned and preserved fruits, the trade in dried fruits is very active. For the year 1877 there were received in that city of dried fruits 1,628,211 pounds. Of this there were transshipped to other points 204,616 pounds.

Philadelphia does a large trade in dried fruits. The immense quantities that are prepared in Pennsylvania and the neighboring States of New Jersey and Delaware find a market in that city. The Southern States on the line of the seaboard also furnish to it very large supplies. It is probably one of the most important distributing points in the East, but in the absence of statistics on the subject we are unable to give even an approximate value of this trade. The amount that enters into consumption in a city of such magnitude must be very great. The dealers represent the trade as prosperous and progressive, and, with the improvements in the methods of drying and the character of the fruits thus prepared, a gradually increasing demand both at home and abroad. Large supplies are furnished from this point to the Western States and Territories and to the mines of Pennsylvania. The exports to Europe are annually increasing, so that the foreign trade is becoming one of great importance.

The reports of the Board of Trade of Philadelphia, while represent-

ing the trade in dried fruits to be one of great value and importance, do not give any statistics as to receipts, &c., and as no census of the business has ever been taken, the main facts in regard to the trade, meager though they be in details and figures, are derived solely from the leading merchants who deal in these commodities.

The receipts and consumption of dried fruits in the city of New York are enormous, but in the absence of any census it has been found impossible to obtain any satisfactory statistics or authentic information regarding the same. The railroad, steamboat, and canal lines centering there enter this commodity on their freight schedules under the heads of "orchard and garden products," and "green and dried fruits," and there is no way of dividing the proportionate quantities to enable one to arrive at the separate amounts.

Leading merchants report a very large and increasing business, and heavy receipts from all parts of the country. The reports of the Boards of Trade, therefore, treat the subject under a general and miscellaneous head, and do not afford any detailed information. A population of a million and a half in the city and its immediate surroundings, together with a floating population of 50,000 daily, must consume a vast amount of dried fruits, which enter so largely into so many necessary preparations for food.

The shipping of this port is the largest in the United States, and the supplies of dried and canned fruits to this trade alone is one of great quantity and value. From this city all the neighboring and interior towns are supplied, requiring immense stocks to be constantly provided. The exports are very large and increasing with the gradually increasing foreign demand. Custom-house entries have the same fault of dealing with shipments of dried fruits under general headings.

Boston has largely increased the consumption of both dried and green fruits. The imports of foreign fruits into that market are important, and the exports of domestic fruits, dried and green, are on the increase. As a distributing point, Boston has yielded the Western market to New York and Philadelphia.

Comparative statement of exports of American fruits during the fiscal years ended, respectively, June 30, 1877 *and* 1876.

Fruits.	Year ended June 30, 1877.		Year ended June 30, 1876.		1877 compared with 1876.	
	Quantity.	Value.	Quantity.	Value.	Increase.	Decrease.
Apples, dried, pounds	14, 318, 052	$920, 292	713, 840	$67, 915	$852, 377	
Apples, green, bushels	1, 146, 929	986, 112	177, 298	221, 764	764, 348	
Other fruit, green, ripe, or dried		268, 282		210, 177	58, 105	
Preserved in cans or otherwise		762, 344		327, 422	434, 922	

Statement of the quantities and values of, and rates of and duties on, foreign fruits entered into consumption in the United States during the fiscal years ended June 30, 1875, 1876, *and* 1877.

Fruits.	Rates of duty.	1875.			1876.			1877.		
		Quantities.	Values.	Duties.	Quantities.	Values.	Duties.	Quantities.	Values.	Duties.
Bananas	10 per cent		$487, 674 21	$48, 767 43		$509, 452 56	$50, 945 24		$416, 733 82	$41, 673 42
Currants	1 cent per pound	19, 334, 458	771, 384 56	193, 344 58	20, 911, 061	856, 425 62	209, 110 61	17, 152, 664	749, 488 00	171, 526 64
Dates	...do	2, 826, 577	76, 257 05	28, 265 77	4, 372, 771	115, 228 80	43, 727 71	3, 973, 185	110, 968 37	39, 731 85
Figs	2½ cents per pound	4, 659, 860	357, 823 99	116, 496 54	5, 056, 779	361, 835 53	126, 419 43	5, 889, 011	398, 982 22	147, 225 32
Grapes	20 per cent		285, 778 27	57, 155 67		253, 892 37	50, 778 47		223, 095 18	44, 619 03
Green, dried, &c	10 per cent		118, 849 42	11, 884 96		258, 259 21	25, 825 93		63, 590 37	6, 359 05
Fruit juice	25 per cent		133, 383 00	33, 345 75		88, 682 35	22, 170 59		74, 346 00	18, 586 50
Lemons and oranges	20 per cent		4, 233, 325 24	846, 664 99		3, 412, 027 45	682, 405 50		3, 073, 304 34	614, 660 93
Limes	10 per cent		25, 812 75	2, 581 27		32, 727 29	3, 272 72		33, 993 99	3, 399 45
Pineapples	20 per cent		286, 331 11	57, 266 19		199, 659 46	39, 931 87		177, 195 16	35, 439 04
Plantains	10 per cent		12, 828 32	1, 282 82		11, 939 40	1, 193 95		9, 443 51	944 33
Plums, dried	2½ cents per pound	12, 339.50	913 00	309 99	2, 925	233 00	73 13	383	17 00	9 58
Preserved in bottles, jars, in brandy, &c	35 per cent		331, 853 09	116, 148 57		264, 113 37	92, 439 67		262, 889 37	92, 011 30
Prunes	1 cent per pound	19, 361, 980	1, 618, 858 70	193, 619 80	55, 358, 764	2, 333, 716 00	553, 587 64	24, 398, 207	1, 254, 783 00	243, 982 07
Raisins	2½ cents per pound	30, 501, 316	2, 443 155 50	762, 532 89	32, 221, 065	2, 425, 277 14	805, 526 63	32, 419, 637	2, 109, 333 60	810, 490 92

Quantities and values of import entries of fruits of all kinds, including nuts, by countries, during the fiscal year ended June 30, 1877.

Countries.	Tons.	Dollars.
Austria	....	159,158 00
Belgium	44	43,962 00
Brazil	....	272 00
Central American States	....	65,801 00
Chili	....	16,475 00
China	....	20,780 00
Danish West Indies	....	152 00
France	....	521,349 00
French West Indies and French Guiana	....	3,564 00
French possessions in Africa	....	5,363 00
French possessions, all other	....	37,330 00
Germany	....	441,502 00
England	747	1,967,989 00
Scotland	250	16,922 00
Gibraltar	....	31,445 00
Nova Scotia, New Brunswick, &c	....	1,901 00
Quebec, Ontario, &c	1,635	26,361 00
British Columbia	....	1,403 00
British West Indies and British Honduras	....	325,843 00
British Guiana	....	9 00
British East Indies	....	394 00
Hong-Kong	....	242 00
British possessions in Africa, &c	....	3,484 00
British possessions in Australia	7	2,214 00
British possessions, all other	....	16,472 00
Greece	....	454,209 00
Hawaii	....	3,877 00
Hayti	....	257 00
Italy	....	2,524,734 00
Japan	....	85 00
Mexico	....	43,171 00
Netherlands	128	7,502 00
Dutch West Indies and Dutch Guiana	....	1,899 00
Dutch East Indies	....	123 00
Peru	....	2,298 00
Portugal	....	8,070 00
Azore, Madeira, and Cape Verde Islands	....	772 00
San Domingo	....	28 00
Spain	....	2,195,055 00
Cuba	....	182,663 00
Porto Rico	....	23,040 00
Spanish Possessions in Africa, &c	....	8,117 00
Turkey in Asia	....	261 00
United States of Colombia	....	112,386 00
Venezuela	....	19 00
All other countries in Asia	....	39,799 00
All other countries in Africa	....	18,027 00
Total	....	9,336,779 00

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